OCTOBER 1955

Journal

VOL. 47 • NO. 10

AMERICAN WATER WORKS ASSOCIATION

Two Parts
PART 1:

Part 2 is AWWA Directory

Extension of Public Services	
Introduction and Resume	Wolman
Federal Aid	Hazeltine
Public Service Commission Viewpoint	Deuel
Sanitary Engineer Viewpoint	Shephard
Fire Protection	Carl
Water Management Program	Watson
Rates and Service Charges	Avery
Water Resources Policy for Washington	Galbraith
Water Utility Safety Practice—Part 3	AWWA Manual
Specifications for Liquid Sodium Silicate	AWWA B404

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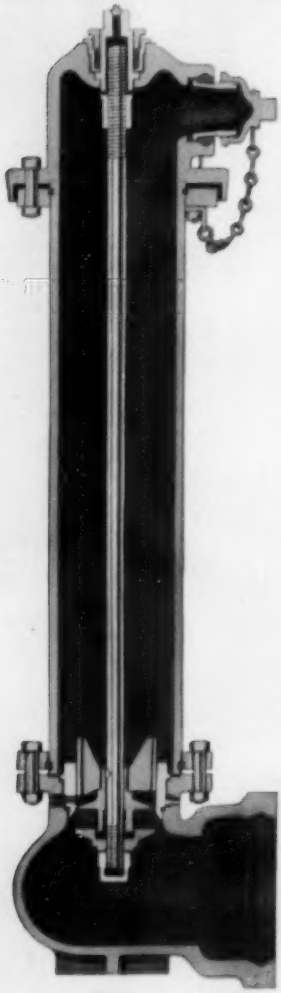
COSTS LITTLE TO MAINTAIN



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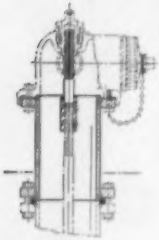

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Journal

AMERICAN WATER WORKS ASSOCIATION

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October 1955
Vol. 47 • No. 10

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Lawrence Farber, *Managing Editor* — Jay K. Klein, *Assistant Editor*

Journal AWWA is published monthly at Prince & Lemon Sts., Lancaster, Pa., by the Am. Water Works Assn., Inc., 521 Fifth Ave., New York 17, N.Y., and entered as second class matter Jan. 23, 1943, at the Post Office at Lancaster, Pa., under the act of Aug. 24, 1912. Accepted for mailing at a special rate of postage provided for in paragraph (d-2), Section 34.40, P. L. & R. of 1948. Authorized Aug. 6, 1918. $7.00 of members' dues are applied as a subscription to the Journal; additional single copies to members—60 cents; single copies to non-members—85 cents. Indexed annually in December; and regularly by *Industrial Arts Index* and *Engineering Index*. Microfilm edition (for Journal subscribers only) by University Microfilms, Ann Arbor, Mich.

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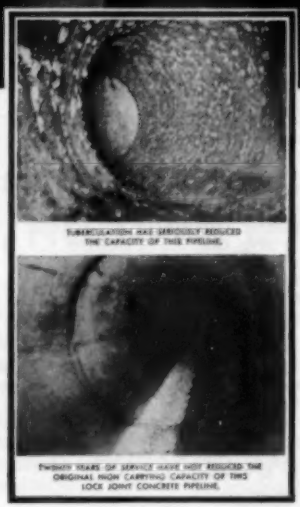

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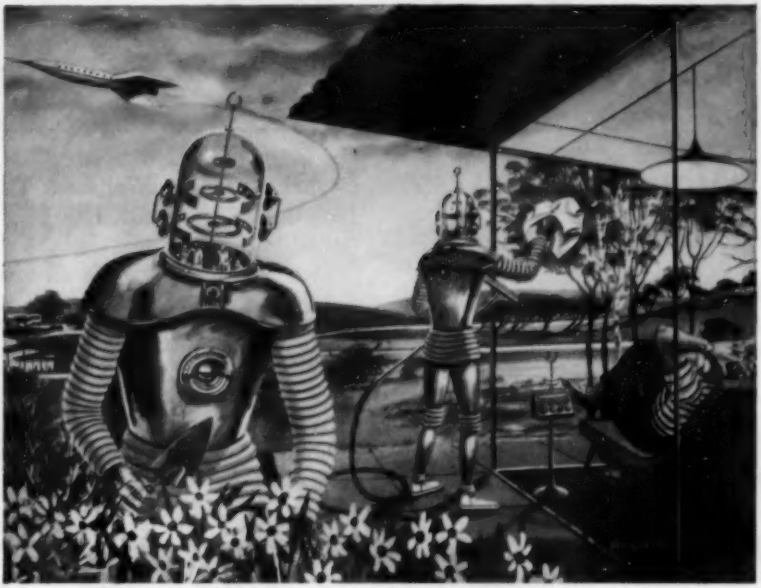

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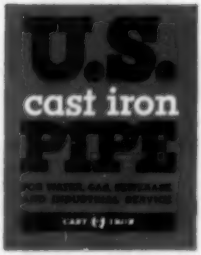

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Coming Meetings

AWWA ANNUAL CONFERENCE

May 6–11, 1956, at St. Louis, Mo. Members' reservation blanks will be mailed after Nov. 1, 1955.

AWWA SECTIONS

Oct. 16–19—Southwest Section at Gunter Hotel, San Antonio, Tex. Secretary, Leslie A. Jackson, Mgr.-Engr., Munic. Water Works, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 17–18—Canadian Section, Maritime Branch, at Isle Royale Hotel, Sydney, N.S. Secretary, J. D. Kline, Box 608, Halifax, N.S.

Oct. 19–21—Iowa Section at Hotel Fort Des Moines, Des Moines. Secretary, H. V. Pedersen, Supt., Water Works, Munic. Bldg., Marshalltown.

Oct. 20–21—West Virginia Section at Waldo Hotel, Clarksburg. Secretary, Harry K. Gidley, Director, Div. of San. Eng., State Health Dept., Charlestown.

Oct. 20–22—New Jersey Section at Hotel Madison, Atlantic City. Secretary, C. B. Tygert, Wallace & Tiernan Inc., Box 178, Newark 1.

Oct. 25–28—California Section, at Senator Hotel, Sacramento. Secretary, H. F. Jerauld, Asst. Supt., Constr. & Operation, Water Dept., 1040 Manzanita Ave., Pasadena 3.

Oct. 26–28—Chesapeake Section, at Sheraton Park Hotel, Washington, D.C. Secretary, Carl J. Lauter, 6955 —33rd St., Washington 15, D.C.

Oct. 30–Nov. 2—Alabama-Mississippi Section, at Buena Vista Hotel, Biloxi, Miss. Secretary, Charles W. White, Asst. San. Engr., State Dept. of Public Health, 537 Dexter Ave., Montgomery 4, Ala.

Nov. 3–5—Virginia Section, at Hotel Roanoke, Roanoke. Secretary, J. P. Kavanaugh, 213 Carlton Terrace Bldg., Roanoke 11.

Nov. 6–9—Florida Section, at Orange Court Hotel, Orlando. Secretary, Harvey T. Skaggs, Secy. & Gen. Mgr., Amica Burnett Chem. Co., Box 2328, Jacksonville.

Nov. 14–16—North Carolina Section, at Robert E. Lee Hotel, Winston-Salem. Secretary, W. E. Long Jr., 1615 Bickett Blvd., Raleigh.

(Continued on page 8)

New booklet shows how Transite Pressure Pipe provides speedy assembly, trouble-free performance

When you use Transite® Pressure Pipe with the Ring-Tite® Coupling you get the immediate benefit of fast and sure and thus lower cost installation. And from then on its trouble-free performance continues to "pay off" through the years. That's why Transite is a natural first choice for dependable water mains . . . a first choice with engineers, municipal officials and contractors alike.

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Johns-Manville TRANSITE PRESSURE PIPE
with the Ring-Tite Coupling

Coming Meetings

(Continued from page 6)

1956

Jan. 17—New York Section Mid-winter Luncheon, at Park Sheraton Hotel, New York. Secretary, Kimball Blanchard, Rensselaer Valve Co., 56 Grand St., White Plains.

OTHER ORGANIZATIONS

Oct. 17–21—National Safety Congress and Exposition, at Conrad Hilton Hotel, Chicago, sponsored by National Safety Council. Secretary, R. L. Forney, 425 N. Michigan Ave., Chicago 11, Ill.

Oct. 22–31—International Congress of Industrial Chemistry, Madrid, Spain. Secretariat, Serrano, 150, Madrid.

Oct. 23–26—Pennsylvania Municipal Authorities Assn., at Bellevue-Stratford Hotel, Philadelphia.

Oct. 24–28—American Society of Civil Engineers Convention, at Hotel Statler, New York.

Oct. 24–26—National Conference on Standards, at Sheraton Park Hotel, Washington, D.C., sponsored by National Bureau of Standards and American Standards Assn.

Nov. 1–3—Panel Conference on Underground Structure Corrosion, at Hotel Niagara Falls, N.Y., sponsored by Northeast Region, National Assn. of Corrosion Engrs.

Nov. 14–18—American Public Health Assn. Convention, at Municipal Auditorium, Kansas City, Mo.

Nov. 16–18—Water Works Management Short Course, at Univ. of Illinois, Allerton Park, Ill.

Nov. 21–22—Hydraulics Conference, at Continental Hotel, Kansas City, Mo., sponsored by Kansas City Section, American Society of Civil Engineers.

Nov. 27–30—American Institute of Chemical Engineers, at Hotel Statler, Detroit, Mich.

Nov. 27–30—National Chemical Exposition, at Public Auditorium, Cleveland, Ohio, sponsored by Chicago and Cleveland sections, American Chemical Society.

Dec. 5–9—Exposition of Chemical Industries, at Commercial Museum and Convention Hall, Philadelphia, Pa., under management of International Exposition Co., New York.

Dec. 11–17—Nuclear Engineering and Science Congress, Cleveland, Ohio, sponsored by Engineers Joint Council.

1956

Feb. 13–18—Symposium on Winter Concreting Theory and Practice, International Union of Testing & Research Labs. for Materials & Structures (RILEM), Copenhagen, Denmark. Organizing Secy., RILEM Symposium 1956, c/o Danish National Inst. of Building Research, 20 Borgergade, Copenhagen, K, Denmark.

Jun. 17–23—World Power Conference, Vienna, Austria. Oesterreichisches Nationalkomitee der Weltkraftkonferenz, Vienna I, Schwarzenbergplatz 1.

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Ease of Operation & Low Cost Installation Sell Waterworks Official on F & P Chlorinator

The Lansdale (Pa.) Municipal Authority furnishes all the water for the Borough of Lansdale. Last year, the Authority provided 406,789,260 gallons from its artesian wells.

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Clarence Godshall, operator at the Lansdale Municipal Authority, taking readings of the chlorine flow rate.

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- Can be installed by unskilled labor

Fischer & Porter offers a wide variety of chlorinators for use in municipal water and sewage systems, industrial plants, and swimming pools. Consult your local F&P representative or write for free literature —without obligation.

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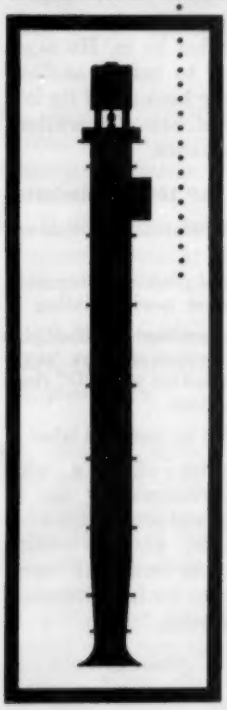

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Designed to Establish a Syphon in Pioneer Application at Donaldsonville, La.

To establish water supply from the Mississippi River to the vast area of Bayou La Fourche, required the utmost ingenuity and cooperation between the State of Louisiana engineers and Economy Pumps engineers. Three 42" x 48" Wheeler-Economy AFV Axial Flow Pumps were selected to do the job. Design capacity is 45,000 GPM at 17' TDH. But when these pumps operate as a syphon they move 65,000 GPM. Motors are 250 HP operating at 514 RPM. Pumps in operation run 24 hours a day.

It is believed this is the first application of pumps of this design to pass such a high volume of water on the syphon principle. Infinite care in planning and construction is typified by the exact length each pump had to meet—51'¾" from underside of mounting plate to end of suction bell. Moreover, every increment assembled in the field had to be made airtight by skilled Wheeler-Economy specialists to make possible the necessary vacuum.

Success was largely assured by Wheeler-Economy's extensive manufacturing facilities in Philadelphia. Here, in one of the largest test pits in the industry, witness tests were made by the State of Louisiana and the contractor to prove pump performance before delivery.

You, too, can rely on Wheeler-Economy for help on complex pumping problems, dependable delivery and performance that lives up to promise.

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WHEELER-ECONOMY PUMPS

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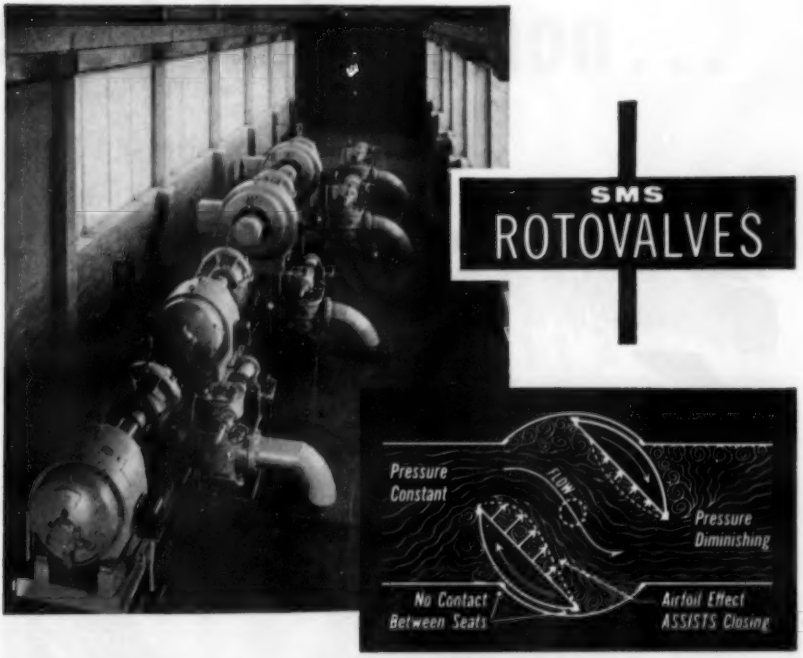

Hydraulic Imbalance Makes SMS-Rotovalves

EASY TO OPERATE

SMS-Rotovalves are easier to open and close. As shown in the diagram, hydraulic imbalance effects an airfoil on the valve's inner surface to assist closing. The conical plug first lifts, then turns on bronze trunnions to eliminate friction and wear on seats, finally reseats. This eliminates the causes of failure and breakage.

Because SMS-Rotovalves need less effort to operate, one man can handle manual opening or closing. In electric operation, smaller motors can be used without increasing operating time. Hydraulic or pneumatic operation requires smaller cylinders and less pressure.

These exceptional performance characteristics are the results of over 75 years of hydraulic research and engineering. For detailed information on our complete line of Rotovalves, Ball and Butterfly valves, write to the S. Morgan Smith Company, York, Pennsylvania.

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what have

The Pacific Salmon will travel many miles and overcome many obstacles to reach the upper stretches of rivers where instinct tells it to lay its eggs. After spawning the fish dies.

This cast iron water main is entering its second century of economical service to the citizens of Sacramento, California.

MODERNIZED cast iron

they in common...

THE SALMON AND CAST IRON PIPE... DEPENDABILITY!

Spawning salmon can be counted on to return to the rivers where they were born. CAST IRON PIPE can be depended upon, too... to give years of trouble-free service, often for centuries.

AND HERE'S THE PROOF: Listed below are some of the many water utilities still using cast iron pipe that was installed a century or more ago.

DEPARTMENT OF WATER AND WATER SUPPLY, City of Albany, New York
ALEXANDRIA WATER COMPANY, Alexandria, Virginia
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Baltimore, Maryland
PUBLIC WORKS DEPT., WATER DIVISION, Boston, Massachusetts
DEPARTMENT OF PUBLIC WORKS, DIVISION OF WATER, Buffalo, N. Y.
WATER WORKS DEPARTMENT, Chicago
COLUMBIA WATER COMPANY, Columbia, Pennsylvania
BOARD OF WATER COMMISSIONERS, Detroit, Michigan
CITY OF FREDERICK WATER DEPT., Frederick, Maryland
PUBLIC SERVICE COMMISSION, City of Halifax, N.S., Public Water Supply
WATER BUREAU OF THE METROPOLITAN DISTRICT, Hartford, Connecticut
MUNICIPAL WATER WORKS, Huntsville, Alabama
BUREAU OF WATER, Lancaster, Pennsylvania
CITY OF LYNCHBURG WATER DEPARTMENT, Lynchburg, Virginia
MOBILE WATER WORKS COMPANY, Mobile, Alabama
QUEBEC HYDRO-ELECTRIC COMMISSION, Montreal, Quebec
PUBLIC WORKS DEPT., WATER-WORKS & SEWERAGE DIV., Montreal, Quebec
PENNICHUCK WATER WORKS, Nashua, N. H.
WATERWORKS DEPARTMENT, City of Nashville, Tennessee
DEPT. OF WATER, GAS & ELECTRICITY, New York, New York
DEPT. OF PUBLIC WORKS, BUREAU OF WATER, Philadelphia, Pennsylvania
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Pittsburgh, Pennsylvania
POTTSVILLE WATER COMPANY, Pottsville, Pennsylvania
BUREAU OF WATER, Reading, Pennsylvania
DEPT. OF PUBLIC UTILITIES (WATER), Richmond, Virginia
DIVISION OF WATER & SEWERS, Sacramento, California
WATER & SEWERAGE DEPARTMENT, City of Saint John, N.B.
DEPT. OF PUBLIC UTILITIES, WATER DIVISION, St. Louis, Missouri
WATER DIVISION, DEPT. OF ENGINEERING, Syracuse, New York
DEPT. OF PUBLIC WORKS, Troy, New York
CITY OF UTICA, BOARD OF WATER SUPPLY, Utica, New York
CITY OF WHEELING WATER DEPT., Wheeling, West Virginia
WILMINGTON WATER DEPT., Wilmington, Delaware
WATER DEPARTMENT, City of Winchester, Virginia
WATER DEPARTMENT, City of Winston-Salem, North Carolina
YORK WATER COMPANY, York, Pennsylvania
WATER DEPARTMENT, City of Zanesville, Ohio

TODAY... modernized cast iron pipe, centrifugally cast, is even tougher, stronger, more uniform. *Where needed and specified,* it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout its long years of service.

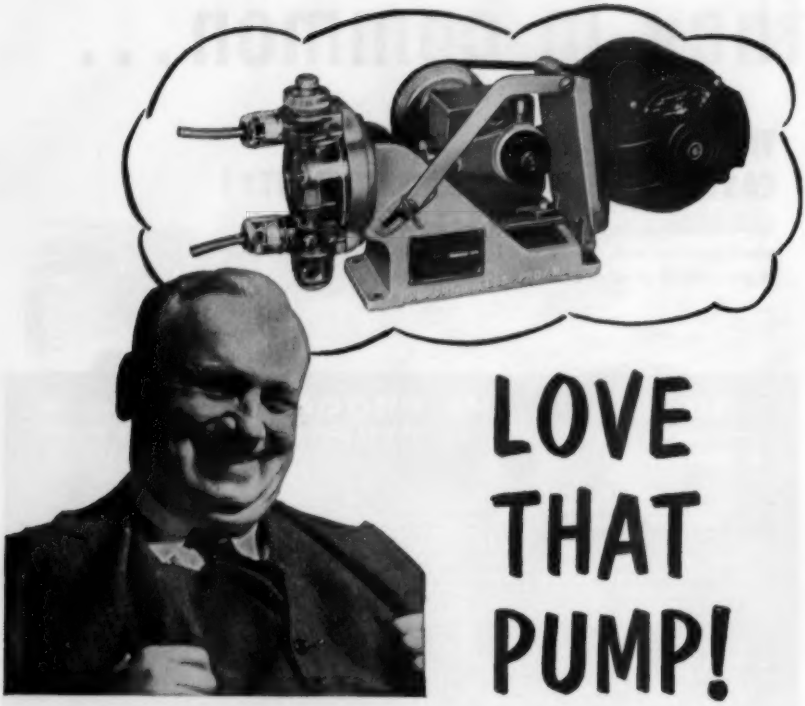
Cast iron pipe's record of performance... measured in centuries... make it the world's most dependable carrier of water.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

CAST IRON

The Q-Check stenciled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS OPERATION



LOVE THAT PUMP!

There's a real feeling of relief to know Proportioneers "Little Red Pump" is in control of your water sterilization problems. Talk to any user of the Heavy Duty Midget Chlor-O-Feeder. He'll tell you about its low installation cost, its negligible maintenance cost, and its rugged dependability. He'll also talk about wide capacity range (up to 8.1 lbs. per hr. of chlorine using 15% Na O Cl) . . . and how easy it is to adjust feeding rate, or service this pump right on the job.

Want details on the pump you can "love" and trust? Send today for Bulletin 1201-1. Proportioneers, Inc., 365 Harris Avenue, Providence 1, Rhode Island.

PROPORTIONEERS

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.

BIF METERS FEEDERS CONTROLS

Meeting specifications is only part of the story behind

HERSEY WATER METERS

It's the quality of materials, workmanship and design, plus their outstanding record for accurate registration and low maintenance cost that make HERSEY WATER METERS the leaders in the water works business.

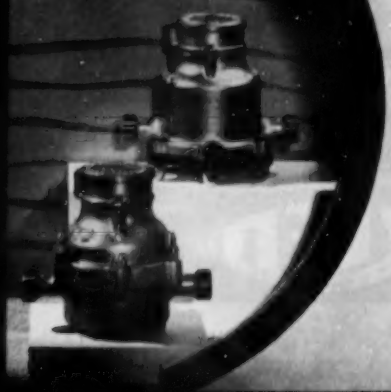
HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. PHILADELPHIA — ATLANTA — DALLAS — CHICAGO SAN FRANCISCO — LOS ANGELES

HERSEY

QUALITY WATER METERS



IF YOU CUT LARGE DIAMETER PIPE...
YOU NEED THESE
New REED HINGED 4-WHEEL PIPE CUTTERS
Four sizes cover the range from 2½" to 12"

Users tell us these completely new cutters are so efficient they often "pay for themselves" through the savings in crew time on a half-dozen cuts. They are the first really practical tools for cutting off steel or cast iron pipe in sizes from 2½" to 12". You can, for example, cut 8" steel pipe completely off in less than five minutes.

Four wheel design requires minimum swing of handle—less digging in ditch work, easier "tight-corner" cuts.

Closed frame permits light weight with complete rigidity for better cutting.

4-point guide aligns the cutter on the pipe . . . assures perfect tracking and a right angle cut.

Reed Razor Blade wheels track perfectly, cut easily and roll down burr on steel pipe.

Unconditionally guaranteed to be the most efficient cutter you have ever used. Ask your jobber or write for literature.

REED MANUFACTURING COMPANY
ERIE, PENNSYLVANIA • U. S. A.

No More "PHONE AND WAIT"

with COC*

Centralized Operations Control eliminates the necessity of telephoning a remote station and then waiting for a man to carry out instructions.

With C.O.C., direct and immediate remote control is yours. You can open and shut valves, start and stop pumps, meter flow, read levels from one central office, over just one phone circuit or radio channel.

C.O.C. is tested, proven and dependable. In most cases, your present instruments can be used. And, C.O.C. can pay for itself in 3 years or less.

For full information, write to The Hammerlund Manufacturing Co., Inc., 460 West 34th Street, New York 1, N.Y. Ask for bulletin W-2.

* Centralized Operations Control

Since 1910 HAMMARLUND

No matter how farsighted today's plans may be...

cities will grow old... in time

Famous "4 Corners," 1890—Courtesy of Rochester, N.Y. Chamber of Commerce

Your best insurance against obsolescence of your water system... specify EDDY Valves and Hydrants *throughout*

No matter how far into the future your city planning is projected, Eddy's record testifies that Eddy Valves and Hydrants are your best long term investment. Eddy Valve Company's more than 100 years of dependable operation means that, today, you can get replacement parts for any Eddy Valve or Hydrant ever installed. And our ability to continue to do so is your assurance against future obsolescence of your valves and hydrants.

EDDY Bronze-Mounted HYDRANTS

open smoothly *with* the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Stem held in place below hydrant valve means that there is no water loss due to a bent stem.

EDDY Bronze-Mounted GATE VALVES

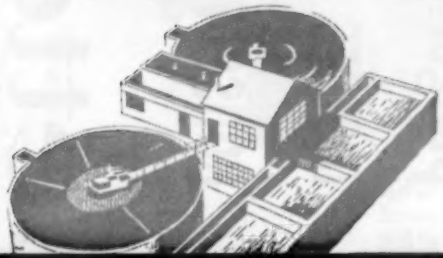
offer simplicity of design, trouble-free operation and enduring service. Each is truly a finished product of workmanship. These factors, added to personal experience, tell why progressive water works men have relied on Eddy for generations.

Eddy Hydrants and Valves are available with hub, flange or mechanical joint connections to fit any existing or planned installation.

EDDY VALVE COMPANY

WATERFORD, NEW YORK

HEART OF BETTER FILTRATION PLANTS

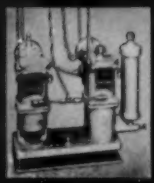


C.-A.-P. SYSTEM® Instruments

Typical "C.-A.-P. SYSTEM" Components

INFILCO Rate of Flow Controller.

"C.-A.-P. SYSTEM" Loss of Head and Rate of Flow Indicator and Recorder.



"C.-A.-P. SYSTEM" Converter.

Typical INFILCO operating table.

In addition to designing all types of gravity filtration plants INFILCO engineers and produces "C.-A.-P. SYSTEM" operating tables, meters, converters and controllers to give you the ultimate in efficient operation. These controls offer great simplicity, accuracy, rugged construction and ease of maintenance. Whether you require a complete gravity filtration plant or efficient controls on your present one, it will pay you to call on INFILCO. Write for complete information on "C.-A.-P. SYSTEM" instruments.

INFILCO

The one company offering equipment for all types of water and waste treatment—coagulation, precipitation, sedimentation, filtration, flotation, aeration, ion exchange and biological processes.

INFILCO INC.

925 South Campbell Ave., Tucson, Arizona

Offices in principal cities in North America 5535

Badger meters conserve it better!

IN only one year, more than *26-million tons of paper* are required to fill the needs of the nation . . . to help business operate, to serve personal needs, to bring your daily newspaper to your door. Yet it takes *more water than wood* to produce this paper.

America help save water for this vital need . . . measure water accurately for

It takes more water than wood to produce this paper

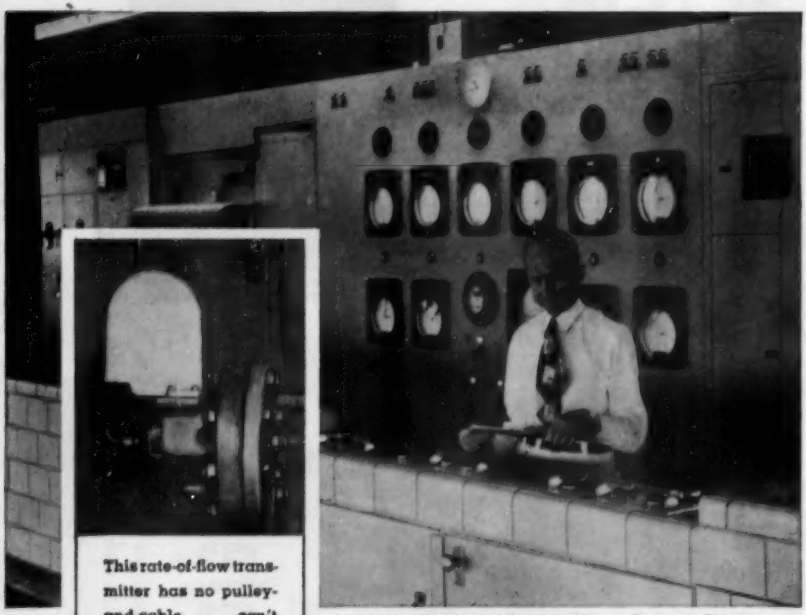
America help save water for this vital need . . . measure water accurately for homes and industry . . . provide a precise check of water usage and waste. And they make certain that users pay fairly for the water consumed . . . help make water departments self-supporting.

As a result of their superior performance through the years, Badger meters are the favorites of waterworks men everywhere . . . famous as the meters that save water, work and money.

Badger Water Meters

Badger Meter Mfg. Co.
Milwaukee 45, Wisconsin

"Measuring the water of the world for 50 years"



This rate-of-flow transmitter has no pulley-and-cable . . . can't be damaged by over-ranging . . . uses no mercury.

At the St. Louis County Water Company's new $1,500,000 filter plant, Hine, Mo., d/p Cell Flow Transmitters tap differential pressure from venturi tubes in effluent lines of 6 filter beds . . . transmit flow measurement to M/40 Controllers shown on panel above. Controllers hold filtration rates at pre-set control points.

Smoothest-working "TEAM" you can get to control filter rates

Here's an unbeatable team for filter rate control . . . a Foxboro d/p Cell* Transmitter . . . an M/40 Controller . . . and a butterfly valve. It costs less to install and less to maintain!

The d/p Cell Transmitter has no pulley-and-cable . . . no mercury. It detects flow pressure differential across its tough metal diaphragm . . . is unaffected by backwash and sand. The Controller maintains flow at exact pre-set flow rates . . . keeps filtration in perfect balance. The rubber-lined valve provides both flow control and tight shut-off.

Write for complete information.

*Trademark

THE FOXBORO COMPANY, 1610 NORFOLK ST., FOXBORO, MASS., U.S.A.

FOXBORO
REG U.S. PAT. OFF.

FLOW CONTROL INSTRUMENTATION

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

SHENANGO VALLEY WATER COMPANY

converts six filters to* ALOXITE® *underdrains

The Shenango Valley Water Company started operation in 1884 with five miles of mains serving 600 customers and 80 fire hydrants. Today, its 140 miles of mains deliver an average of 7 MGD to 14,000 homes, businesses and institutions in the Sharon-Shenango Valley region of Pennsylvania.

The company's eight filters have a capacity of 8 MGD. Its first ALOXITE aluminum oxide porous underdrain was installed in 1952. Since then, five more filters have been similarly modernized — the sixth set of ALOXITE plates is about to go into service.

This continuing program of filter modernization speaks well for the operating advantages provided by filters built with ALOXITE underdrains: elimination of upset beds . . . complete backwashing . . . freedom from mudballs . . . minimum loss of head.

It is easy to see why the Shenango Valley Water Company has been able to keep so well abreast of the growing water needs of the area it has served so long. The company's management and engineering staff deserve much credit for their progressive policy.

CARBORUNDUM

Registered Trade Mark

Dept. 6105, Refractories Division,
The Carborundum Company, Perth Amboy, N. J.

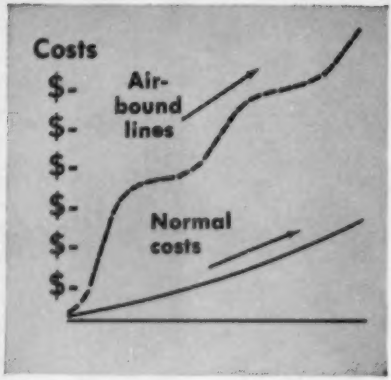
This informative 56-page booklet covers porous media for all fields of filtration and diffusion. Write us for your free copy today.

COST CUTTING

HOW TO CUT PUMPING COSTS

• When air lodges in high spots, it cuts the effective area of pipe, creates a friction head, lowers pumping capacity . . . and may cause water-hammer.

Simplex Air Release Valves end these troubles. They vent air automatically to eliminate binding, increase efficiency, cut pumping costs. Simple, rugged 2″ size, for up to 250 psi., costs you little, quickly pays for itself! BULLETIN 1204



HOW TO PREVENT PIPELINE COLLAPSE

• A break in the line or a quickly opened valve often releases water at terrific velocity. Internal pressure falls below atmospheric. Thin-walled pipelines collapse!

Simplex Air Inlet Valves quickly admit air, prevent a vacuum, protect lines from collapse. They also vent air when lines are being filled to stop binding, increase efficiency. Standard 4″ to 10″ sizes.
BULLETIN 1202

Pipeline collapse due to vacuum

WRITE for Technical Bulletins! Simplex Valve & Meter Company, Dept. JA-10, 7 E. Orange St., Lancaster, Pa.

Accurate instruments and controls since 1904

SIMPLEX®

VALVE AND METER COMPANY

Difficult problems overcome—yet water costs only 3½ cents per 1000 gallons!

Chardon, Ohio solves water problems

WITH A

BJ SUBMERSIBLE

Chardon, Ohio, faced these difficult problems:

1. The proposed well site was a flood area.
2. It was on a golf course where unsightly pump houses would mar the landscape.
3. It was 1½ miles from the water tower.

RESULTS TALK!

The Chardon Board of Public Affairs worked with Byron Jackson Co. engineers. A 30 horsepower Subette rated at 250 gpm against a head of 360 ft. was installed in a simply-constructed pit. Unseen and completely submerged, this single Subette pumps one-half of the town's water supply. It eliminated an unwanted pump house and solved the dangers of flood-out during high water. In addition, the BJ Subette is pumping water at an operating cost of only 3½ cents per 1000 gallons!

For larger cities, BJ Submersible models are available in capacities to 20,000 gpm and heads to 1800 ft.

Write for complete information

BJ

SINCE 1872

Byron Jackson

Division of Borg-Warner Corporation

P. O. BOX 2017, TERMINAL ANNEX
LOS ANGELES 54, CALIFORNIA

Sales offices in all principal cities

It's almost magic, the way Morton can come up with any kind of salt you need in a hurry!

There's really no trick to it. For Morton makes salt for every industrial use under the sun—canning, meat packing, freeze-proofing, water softening, brine making—to mention but a few.

We can ship it to you the fastest possible way — by train or truck — without any hocus-pocus. Morton has nine strategically located plants to serve you. This makes it possible for Morton to offer fast delivery on a carload to a trainload, at the most favorable prices and freight, *anywhere* in the country.

Got a water softening unit?
Want better results? Need help in planning a new brine installation, or in converting an old one? Call on Morton. One of our Consulting Engineers in your area will be out to give you valuable technical assistance—at no cost to you!

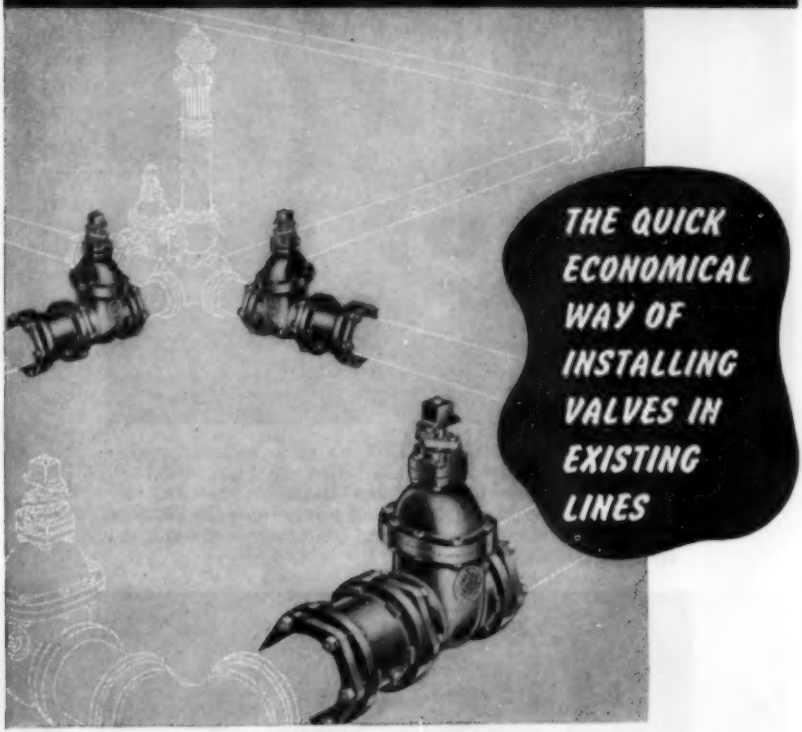
For fast delivery of the salt you need—for expert technical help, too—write, wire, or telephone this week to:

MORTON SALT COMPANY

Industrial Division, Dept. JA-10, 120 South LaSalle Street, Chicago 3, Illinois

Telephone: Financial 6-1300

SMITH CUT-IN VALVE AND SLEEVE



The Smith Mechanical Joint Cut-in Valve and Sleeve is truly the answer to the problem of installing gate valves in existing piping which can be relieved of pressure. The design reduces size of excavations, installation time and in-service cost to the minimum. Two substantial stop screws lock the Valve and Sleeve securely in place.

The Cut-in Valve and Sleeve can be installed on any standard class of cast iron pipe. Molded rubber gaskets fit into machined "Stuffing Box Type" joints, which are permanently leak proof. Smith Cut-in Valves are manufactured in compliance with the A.W.W.A. gate valve specification. Write for Bulletin MJ2.

55

THE A.P. SMITH MFG. CO.
EAST ORANGE, NEW JERSEY

EAST AURORA GOES "AUTOMATIC"

AUTOMATIC HARDNESS TESTER on each softener makes soap tests at required intervals. When the water tests hard —regardless of the volume treated—the tester automatically activates the multiport valve that regenerates the softener . . . insuring maximum runs and uniformly soft water despite variations in wells.

AUTOMATIC MULTIPORT VALVE, being checked by operator Bob Fox, takes a softener out of service, backwashes, regenerates and rinses the bed and returns the unit to service —smoothly and automatically—with no attention or supervision.

AND CUTS SOFTENING COSTS

When population jumped to 6,800, East Aurora increased pumpage by 72% from 320,000 to 550,000 gpd. Even at this increased volume, they cut salt costs $4000 a year! They also ended a red-water problem by reducing iron from 1.3 ppm to 0. And they use the *same manpower!*

HOW WAS IT DONE? The increased volume and salt savings were accomplished by using Permutit Q, a high-capacity ion exchange resin with low salt consumption. The iron problem was solved with two Permutit filters. Manpower was not increased because the automatic hardness testers eliminated manual testing. And the efficiency of Permutit's automatic multiport valves frees the operators for other plant duties.

WHY PERMUTIT? "We started with Permutit equipment in 1935, and it worked out so well that we called on Permutit again for our 1950 expansion," says Village Engineer E. J. Maurer.

Permutit will work with you to modernize your present plant or to plan a new one. Call us early in the planning so we can be of most help. The Permutit Company, Dept. JA-10, 330 West 42nd Street, New York 36, N. Y.

A 51% increase in population caused East Aurora, N. Y. to expand and modernize its water works. Wooden structure (left) was replaced by a modern brick building which contains the latest in water conditioning equipment.

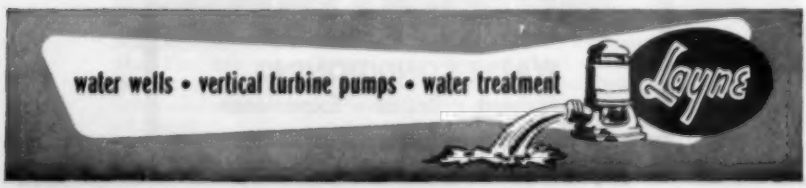
PERMUTIT®
WATER CONDITIONING
Equipment • Resins • Experience

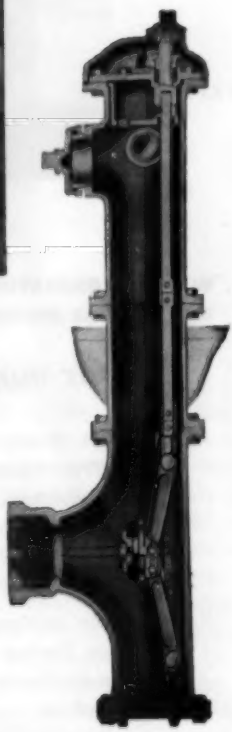
the tale of two cities
—one city did...one city did not!

The city fathers of "the city that did" blueprinted the future. With the help of "the man from Layne" they projected industrial and population growth into the future and kept water supply ahead of demand. The result? . . . continued progress . . . accelerated prosperity, for growth depends upon water supply.

On any question that relates to water, wise civic planners "ask the man from Layne."

LAYNE & BOWLER, INC.
Memphis 8, Tennessee
Layne Associate Companies Throughout the World





22 MINUTES
for Complete Hydrant Inspection
WITH RENSSELAER

The illustrations show how easy it is to remove and inspect the entire mechanism of the Rensselaer-Corey Fire Hydrant which has been the standard in many cities for more than half a century.

The parts can be removed, inspected, and replaced in twenty-two minutes. No digging for repairs or for standpipe breakage. This hydrant opens with the pressure, by means of the powerful knuckle joint. Easy to operate and cannot stick. It is quick opening with free flow long radius curves. Hydrant will not flood.

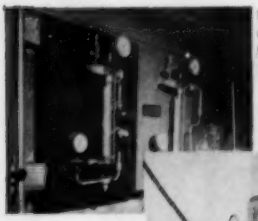
Ask for Catalog No. G and see why the Rensselaer-Corey Hydrant is preferred by superintendents, fire chiefs and maintenance men. **106D**

Rensselaer VALVE CO. **TROY, N. Y.**

AIR VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES • CHECK VALVES • AIR RELEASE VALVES

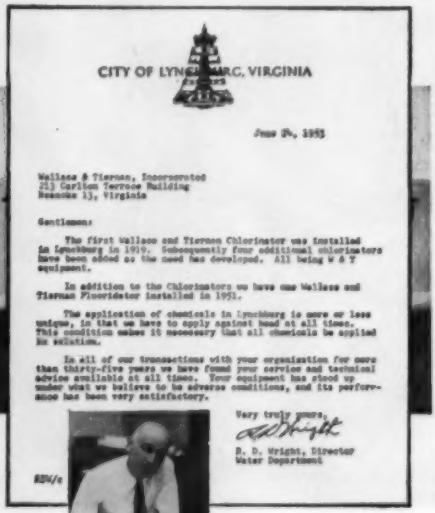
SALES REPRESENTATIVES IN PRINCIPAL CITIES

Division of The Ludlow Valve Manufacturing Co., Inc.



W & T 1919 type mechanical diaphragm chlorinator

Modern W & T type water diaphragm chlorinator



CITY OF LYNCHBURG, VIRGINIA

June 9, 1953

Wallace & Tiernan, Incorporated
213 Carlton Terrace Building
Roanoke 13, Virginia

Gentlemen:

The first Wallace and Tiernan Chlorinator was installed in Lynchburg in 1919. Subsequently four additional chlorinators have been added as the need has developed. All being W & T equipment.

In addition to the Chlorinators we have one Wallace and Tiernan Fluoridator installed in 1951.

The application of chemicals in Lynchburg is more or less unique, in that we have to apply against head at all times. This condition makes it necessary that all chemicals be applied in solution.

In all of our transactions with your organization for more than thirty-five years we have found your service and technical advice available at all times. Your equipment has stood up under what we believe to be adverse conditions, and its performance has been very satisfactory.

Very truly yours,

R. D. Wright, Director
Water Department

RDW/e

W & T CHLORINATORS — DEPENDABLE SERVICE...

"...for more than thirty-five years..."

Mr. R. D. Wright, Director, City of Lynchburg Water Department writes, "Your equipment has stood up under what we believe to be adverse conditions, and its performance has been very satisfactory." Lynchburg, Virginia has been using Wallace & Tiernan Chlorinators since 1919. *The original units are still in service,* along with more modern W&T equipment.

When you purchase a W&T Chlorinator, you purchase more than apparatus. You buy experience. Experience that brings you equipment design and materials of construction that have been selected and proven by years of use.

Lynchburg is not the exception. When your W&T representative visits you he can tell you about W&T chlorinators in your area, which are still giving dependable service after years of use.

"Make Your First Choice Equipment That Lasts."

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

S-101

Journal
AMERICAN WATER WORKS ASSOCIATION
VOL. 47 • OCTOBER 1955 • NO. 10

Extension of Public Services to Suburban Areas

Panel Discussion

A panel discussion presented on Jun. 15, 1955, at the Annual Conference, Chicago, Ill.

Introduction—*Abel Wolman*

A paper presented by Abel Wolman, Prof. of San. Eng., Johns Hopkins University, Baltimore, Md.

OVER the last quarter of a century there have been two crises in the water works field of extremely dissimilar character that left an impact from which the industry finds difficulty in recovering. The first of these, of course, was the depression, during which the water utilities were confronted with the difficulty of remaining solvent despite reductions in revenue.

Water works are now confronted with a different kind of a crisis, in which expansion and demand for service has proceeded at such a pace that the industry finds itself embarrassed in a number of the areas of rapid growth. The current period has been described as an era of "metropolitan spill," which dates from approximately 1940. Surprising almost everyone in the United States, this phenomenon had, of course, many origins and causes, one of which was the unexpected desire of families to have children. This factor was overlooked in prophecies made prior to 1941 by biostatisticians, water works management, economists, politicians, and other informed persons. People have a tendency to surprise the experts by frequently doing the improbable and the unpredictable. Today, this country has a population of more than 165,000,000, an amount that was not supposed to be reached until 10–20 years from the present. The number of inhabitants anticipated for 1960–80 is a figure which was believed could not be reached before the year 2000, if at all. As the new families have developed, so has the need for

dwellings. In 1955 considerably more than 1,000,000 houses will be built.

With modern improvements in transit, with the opportunity afforded people to move around since 1940, and with the increased pace of life since 1945, the United States has become a country of nomads, outdoing the Indians of North America. Families and their offspring, continually on the move at higher and higher speeds, have growing desires to move farther and farther away from the central core of old cities. Such inclinations create difficulties in providing community facilities.

Need for New Facilities

All of the many problems, such as undue growth, the opportunity for living far away from the place of work, the desire to have individual homes, and the backlog of construction accumulated during the war period, have pressed the water works utilities, the sewage industry, the construction field, the schools, and the churches. The facilities that are necessary for community living are severely strained by families who have moved in areas which only a few years ago were farmlands. During 1950–54 in a western state, for example, a new city, equivalent in population to Pittsburgh or New Orleans, arose on the periphery of an old municipality.

Water works management is usually divided into two classes. One of these is composed of nostalgic persons who would like to turn the clock back to the comfortable period just prior to World War II. They would like to feel that the expansion of their industry need not proceed at an accelerated pace. The second group, aware of the realities of the modern world, would like to find solutions to today's difficulties. The papers that follow have something to say about the problems enumerated in this introduction. Planning today must be accomplished quickly because the needs are urgent and delay will prove harmful. In providing services for great metropolitan areas, new thinking is necessary to dislodge water works from the orthodox concepts of the previous decades. These questions must be answered in coping with future developments:

1. What type of physical layout is necessary in meeting the needs of suburban areas?
2. How can new administrative structures be set up?
3. In attempting to provide community facilities for 500,000 persons in a relatively densely settled area, how can a water works management best work with county officials who still feel they are dealing with rural and farm problems primarily?
4. How can a utility secure the funds necessary to its expansion; what is the financial capacity of the newly populated areas; and what are the policies that have to be pursued in order to develop its facilities?
5. What kind of a political organization is available to a utility in carrying out its development?

Expansion of Services

Restricting service, a common practice in the past, must give way to meeting the immediate needs of a locality. A considerable amount of material has recently been presented in the JOURNAL and other publications on how to finance the extension of water mains. Most of these articles were directed toward reducing the opportunity for the extension even beyond the limitations of the past 10–20 years. The

philosophy back of such reasoning is, of course, that the problem of financing has not been solved. There is a conflict between desire to service an area and the physical necessity for not doing so. The privately owned water company is pressed to build its lines into areas which will not develop at a rate sufficient for prompt refinancing. Under such conditions, the utility must try hard to keep its capital structure intact within the Public Service Commission's rules and within the investor's desires.

The water works industry, today, is trying to get some other segment of the economy, usually the private entrepreneur, to finance the development. Municipalities have unconsciously forced the realtor or the subdivider, whether he likes it or not, to become the public banker for the water works industry and the other utilities. In the author's judgment, such a situation cannot endure because that is not his function and he is not well adapted to providing in an orderly, desirable way for the expansion of facilities.

Federal Aid—*John C. Hazeltine*

A paper presented by John C. Hazeltine, Comr., Community Facilities Admin., Housing & Home Finance Agency, Washington, D.C.

A description of the US Housing and Home Finance Agency and its arrangement may be of value in future contacts with the organization and should be useful in giving a better understanding of the overall federal housing activities. The administrator of HHFA is charged with the responsibility of advising and reporting to the President and the Congress on all matters pertaining to housing within the United States and its territories. Six constituent units are included within the HHFA:

Federal Housing Administration (FHA); Public Housing Administration; Urban Renewal Administration; Federal National Mortgage Assn.; Home Loan Bank Board; and Community Facilities Administration (which the author represents as a commissioner).

The headquarters of all of these organizations are located in Washington, D.C., where an advisory council, consisting of the administrator as chairman and the commissioner or head of each individual agency, convenes at regular intervals for discussion and planning at the top level. The FHA, Public Housing Administration, and Federal National Mortgage Assn. each operates its own regional and field offices, located strategically throughout the country, and the Home Loan Bank Board is in direct contact with the savings and loan associations.

The Housing and Home Finance Agency maintains six regional offices, each headed by a regional administrator answering directly to the administrator, and about 25 area and field offices directly responsible to the regional administrators. These HHFA regional offices are adequately staffed with legal, engineering, fiscal, and economic experts and administrative assistants. The administrator, the Urban Renewal Administration, and the Community Facilities Administration employ the talents and skills of these offices to aid in developing the programs in a highly coordinated and integrated manner at the local level.

The regional administrators are also charged with maintaining close and cooperative contact with the directors of the local offices of the other constituent agencies. By this type of organization, the same degree of coordination existing in Washington is maintained throughout the country.

Of prime importance is federal recognition that the provision of housing in the United States is, as it has always been, chiefly the function of private enterprise. The government, concerned with the importance of a stable and prosperous housing industry to the national economy, attempts to play an indirect and influential role in stimulating production and assisting in all housing problems. Aside from emergencies, such as war, the federal government takes only a supplementary role and in no way attempts to supplant private and local housing and community development activities.

The problems of housing throughout the nation are numerous and varied. For many years, solutions were attempted through a rather uncoordinated group of laws and agencies. Many complicated problems failed to receive proper overall attention or were overlooked altogether simply because no one law or centralized agency had a scope broad enough to cope with them.

The principal housing agencies of the federal government were consolidated temporarily during World War II. They were brought together in 1947 on a permanent basis under the Housing and Home Finance Agency. Various laws thereafter, culminating in the Housing Act of 1954, presently provide the necessary broad-scale legislation. Housing and community development problems can now be attacked in a properly integrated and efficient manner, and some of the biggest obstacles to housing progress can be tackled.

Housing Finance

Financing, of course, is of prime importance as the bridge between the homebuilder and the homebuyer. Three Housing and Home Finance Agency constituent agencies are directly involved in fiscal operations. The Home Loan Bank Board provides a nationwide credit reserve for member institutions, which are the familiar savings and loan associations in every town. Local savings are invested through them and made available for home-building activities at the local level. The HLBB insures the savings of the many investors in these institutions, which handle more than one-third of all home mortgage financing in the United States.

Supplementing private investment in housing, the Federal National Mortgage Assn. provides a secondary market for FHA-insured and GI home loans, buying and selling such mortgages and, thus, assuring a steady and long-term market for them. Under the Housing Act of 1954, FNMA was reorganized to make private capital its normal source of funds but it may still support special needs where private financing is not adequate.

The FHA provides government insurance of private loans for purchasing, constructing, and repairing single and multifamily dwellings, providing security to the lender and, through liberal terms, enabling families of moderate means to buy or improve their homes. By making sound investment feasible for the great mass of American families, FHA programs have resulted

in an increase in home ownership to an all time high of 56 per cent. FHA has also assisted in large-scale development programs. Its standards for construction, sites, utilities and community facilities have contributed greatly to the improvement of housing for the average citizen.

Slum Clearance

Many thousands of families which still cannot afford decent private housing are living in crowded and unsanitary slums. Through the Public Housing Administration, the federal government makes available funds to public agencies for the purpose of building low-rent public housing for the benefit of the low-income family living in substandard dwellings. In addition, PHA provides an annual subsidy to the local public agency to assist in maintaining the rents within the means of the tenants. Most of the public housing is of the project type, much of which is built on former slum sites, thus helping the cities rid themselves of deteriorated problem areas. The complicated problem of slum clearance, however, cannot be completely solved by public housing. In 1949 Congress authorized federal loan and grant assistance to local communities to permit them to clear and redevelop slum areas. This original program, under which more than 7,000 acres of deteriorated congested urban areas were cleared, replanned, and redeveloped, served merely to assist cities in clearing slums after they had come into existence, but did nothing to prevent and arrest the vast spread of blight or to rehabilitate declining areas which would soon become typical slums. The President, therefore, called for a broader program to provide for prevention and rehabilitation, as well as mere clearance. This undertaking became the Urban Renewal Program of the Housing Act of 1954, under which the Urban Renewal Administration provides loans, grants, and technical-planning assistance for the prevention and cure of urban blight.

A significant feature of this operation is the comprehensive, so-called "workable program," which includes not only slum and blight prevention, but also plans for future public works, community facilities, and thoroughfares. Brought together in this undertaking are the facilities of the FHA, the Urban Renewal Administration, the Public Housing Administration, and the Federal National Mortgage Assn. Each of these units must work with the others to provide the overall contribution.

Every segment of the Housing and Home Finance Agency understands the importance of community facilities to housing and community improvement. The commissioner of the FHA faces such problems daily. It is necessary that FHA-insured homes have proper facilities and utilities to provide not only for the convenience, health, and welfare of the homeowner, but also for marketability of the mortgages insured by the agency. FHA regulations require connections with existing systems owned and operated by municipalities, counties, districts, or private corporations. In some localities, connections to a central system are not feasible and, where site and soil conditions are satisfactory, wells and septic tanks are acceptable, although the FHA is reluctant to authorize these facilities.

The Public Housing Administration must also require high standards of community facilities. The local agency must plan and provide adequate sewer, water, and other utilities before it can qualify for assistance.

The Urban Renewal Administration must be assured that basic facilities are included by the community as part of the planning of areas for sound redevelopment. For this reason, the federal urban renewal legislation permits the cost of such installations to be included for loan purposes.

Need for New Facilities

No informed person need be reminded of the heavy demand for community facilities occasioned by increasing population. The American Society of Planning Officials recently developed some interesting data from the records of three well administered cities and, based on an average composite family group, produced some dramatic figures. An influx of 100 new families means an increase in population of approximately 450 persons. There will be 100 new children requiring four additional teachers and 3.85 schoolrooms costing approximately $120,000. The water department will have to increase its capacity by 10,000 gpd. About 140 more vehicles will be added to traffic congestion. Several additional employees must be added to the municipal payroll to assist in the administration of water, health, police, fire, and other municipal services. The foregoing estimates are for only 100 families, and nearly every large community today is faced with the problem of providing for thousands of new householders. Without continual expansion of community facilities, housing production cannot proceed rapidly enough to fill the needs.

The US Dept. of Commerce has recently estimated that 25 billion dollars will be needed over the next 10 years to provide community facilities for expanding areas. Based on 1954 costs, 10 billion dollars worth of construction is necessary to remove the accumulated backlog. Another 15 billion dollars should be expended to offset obsolescence and depreciation and to keep pace with the rapidly increasing per capita use. To furnish such utilities would require an average annual expenditure of 2.5 billion dollars, compared with the present yearly rate of slightly more than 1 billion dollars.

Importance of Supply

From the overall standpoint of the actual continued existence of some cities in the United States, it is interesting to look into history. The great ancient metropolises of Ur, Susa, Persepolis, and Nineveh, once proud capitals of great empires, now have passed into oblivion mainly through lack of water. The city of Kish disappeared under the sands when its water supply, the Euphrates, changed its course. Thereafter, Babylon arose and flourished for hundreds of years, but it, too, failed to keep pace with demands for water. The farsighted citizens of Rome first met the problem in a realistic manner and provided water through an extensive aqueduct system. Fourteen massive stone aqueducts carried the supply that maintained the Eternal City at the head of an extensive empire for many centuries. The people of today owe a great deal to the old Romans for their pioneer engineering work.

The great cities of the world are now required to go farther and farther for their water supply. The tremendous expense of the installations is more than justified by the results produced. To cite only one example (remembering that there are many, many more), the farsighted planners of the metropolitan area of Southern California conceived and constructed the Los Angeles Metropolitan Water Project, which brings water from the Colorado River across deserts and through mountains, a distance of about 200 miles, to supply a rapidly expanding population. Probably, few persons realize that the cost of this water system to this one group of communities is practically equivalent to the cost to the United States of the construction of the Panama Canal. It is rather frustrating to know that the huge new water project will be operating at its total possible capacity within a very short time and that additional projects are now necessarily in the planning stage.

Financial Aid

The Community Facilities Administration in Washington possesses a seasoned, professional staff experienced in planning, financing, and constructing all types of community facilities and has available through its several programs much aid for states, municipalities, public bodies, and other institutions. In times of war or intense defense activity, CFA has been called on to administer programs providing for direct federal help to communities in critical, high-production areas. When disaster hit, CFA assisted in repair and restoration of damaged public works. Although many of these programs are now terminated, several still exist for assistance where private financing is not available. CFA administers the College Housing Loan Program, under which 40-year loans are available to overcrowded institutions of higher learning for the construction of badly needed dormitory facilities. Serial bonds for the total amount of the site and improvement costs will be purchased by the government if the college or university is able to provide the necessary debt servicing and if private lending institutions do not bid these securities in at a comparable rate of interest. Every effort is being made to assist the colleges and the universities in so preparing their programs that private investors will supplant the government in the purchase of the bonds.

In conjunction with the Office of Education in the US Dept. of Health, Education, and Welfare, the CFA provides, on a contract basis through the Housing and Home Finance Agency field offices, the facilities necessary to advance the construction of elementary schools under the federal educational assistance programs. Such aid includes legal review, engineering inspection, and auditing. For schools not run by the federal government, these services are advisory to the local school board. Federal schools, such as those on military reservations, are the full responsibility of CFA, and contracts are made directly with architects and contractors.

Under Public Law 163, the CFA will provide federal funds on a business arrangement for the construction of needed public works. These loans may run for as long as 30 years and currently draw 4¼ per cent interest. More than 300 communities have made specific inquiries, showing wide-

spread interest. Because present loan funds are meager, the CFA is forced, from an administrative standpoint, to consider only projects of the highest priority for water, health, and sanitation. About 66 public bodies are now perfecting their applications, a large majority of which will be for water supply systems for small, very needy communities.

Advance-Planning Aid

Of special interest to water utilities is the Third Advance Planning Program administered by the Community Facilities Administration for the Federal Housing Administration. That the lack of planning funds is a key problem in many communities has long been recognized by Congress. As far back as 1944, it foresaw the need and value of advance planning and enacted the First Advance Planning Program, which lasted 3 years, terminating in 1947. The Second Advance Planning Program, provided in 1949, was ended in 1951 due to the outbreak of the Korean conflict. These two programs stimulated the construction of approximately 3.6 billion dollars' worth of projects, about half of which comprised water and sanitary facilities, the balance consisting of public buildings, schools, parks, hospitals, roads, and other public works.

Normally, a community may not legally contract to expend funds for the planning of specific projects until the money necessary for construction has been authorized by the local government. Thus, it is very difficult to plan a well regulated progressive development, and communities often must resort to providing for only the barest of currently existing requirements. Partially for this reason, it is estimated that the United States as a whole continues to remain about 25 per cent behind current needs, and many new projects supply yesterday's wants rather than tomorrow's. The use of government interest-free advances legally bridges the gap between preliminary planning and actual construction, providing a method whereby local public bodies may progress in an orderly manner toward the solution of their problems.

The Housing Act of 1954 authorized $10,000,000 for the Third Advance Planning Program, which is to last 3 years. Although this project is now in effect and many applications are being processed, it was until recently operated on a very restricted basis because of the lack of appropriated funds. These limitations have been removed and many applications which formerly were deferred are now being reviewed. The President considers this program so important that he has recommended to the 84th Congress that the law be amended for expansion and flexibility. The administrator would then be authorized to establish a revolving fund which would continue indefinitely, and a total of $48,000,000 would be made available within the next three fiscal years. Communities would be eligible for planning advances for needed public works that normally would be expected to be placed under construction in the reasonably near future. The communities would have assurance that they would be able to obtain additional advances thereafter for correlated plans for construction at a later date. This procedure should go a long way toward eliminating the guesswork always present in an inordinately long-range program and should reduce obsolescence of plans caused by rapid technological progress.

The administration feels that the advance-planning program is an aid to the community and that the reservoir of well planned public works produced will permit a constant high level of such construction, thus helping to maintain the economic health of the nation. The scope of the planning is being restricted to the necessary preliminary plans sufficient to furnish the basis for a close estimate of final costs. Because the preliminary planning often requires the greater portion of the time necessary for total planning through to details and specifications, projects generally may be placed under construction much more quickly if all of the initial work has already been accomplished. By limiting the planning to the preliminary stage, it is hoped that $1 of federal advance money may return up to $100 of actual construction value. These advances are not grants and are repayable when construction is commenced. It is specifically provided that such aid in no way obligates the federal government for any construction costs.

Widespread interest has already been shown in this program and it is to be hoped that the sound thinkers in charge of the great future of the local public bodies will take advantage of government assistance. Detailed information about the Third Advance Planning Program may be obtained by the public body on application to the Housing and Home Finance agency regional offices for the area. This procedure is required in order to provide a control for statistical information and cooperative followup. The entire regional staff is anxious to lend every assistance.

NOTE: Since this paper was written, the housing amendments signed into law by the President on Aug. 11, 1955, have removed the Home Loan Bank Board from the group of constituent units under the Housing and Home Finance Agency administrator; increased the college housing authorization from $300,000,000 to $500,000,000; increased the public facility loans program to an authorization of $100,000,000; and increased the authorization for the program of advances for public works planning to a total of $48,000,000.

——Public Service Commission Viewpoint—*Orville P. Deuel*——

A paper presented by Orville P. Deuel, Rate Analyst, State Public Service Com., Madison, Wis.

Suburbs of Wisconsin cities usually are either located within the city limits or situated immediately adjacent to the city in incorporated or unincorporated areas. The outlying districts in which water service is a problem are generally found in unincorporated localities. A report based on the 1950 census presents statistics on the population of four urbanized regions, including four central cities, 15 incorporated places, and unincorporated territory (*1*). If it is assumed that extension of utility service as a major problem is limited to unincorporated locations, the residents of such areas could be used as an indication of the percentage of the urban population involved. In 1950, approximately 6 per cent of the inhabitants in the four urbanized areas lived in unincorporated places. Included in this estimate would be some

persons served by a municipal sanitary district, a fact that would reduce the number with a supply problem. Inasmuch as there are sections of incorporated regions without a public water supply, however, the two factors could offset each other and make reasonable a conclusion that approximately 6 per cent of the nonfarm population has a utility difficulty.

Privately Owned Utilities

Privately owned water works usually make no distinction between urban and suburban areas and have accepted the obligation to render service to all applicants under terms of a reasonable main extension policy. The customers of these utilities, which furnish water to fourteen communities, comprise only about 3.4 per cent of the total population living in localities where a public supply is available. Four of these communities are cities and ten are villages. The extension rule in three of these cities provides for a 50-ft extension without a customer advance, or, if more favorable to the customer, the utility will invest up to four times the annual revenue from the extension. When an extension exceeds the so-called "free limit," a contribution equal to the excess cost is required.

In the fourth city, the utility's policy is to invest up to four times the estimated annual revenue, including recompense for public fire protection service. In all cases, refunds are made if customers connect within a specified number of years. The policy of the Public Service Commission is to require that water works provide extensions if the applicants are located where the utility has undertaken service. The customer, of course, must comply with the extension rule, and, in practice, all such service is provided where applicants agree to the terms.

Water main extension into suburbs by privately owned water utilities is facilitated by Wisconsin statutes (Sec. 62.19 [1] *) which permit the use of the taxing powers of the municipality in financing such construction. These laws require that where a utility has a written contract with a city for laying mains on order of the municipal council, the board of public works must make an assessment upon property benefited by the extension. Such written agreements are employed by three Wisconsin towns.

Municipally Owned Utilities

The Public Service Commission comes in contact with extensions in three important aspects where the central-city water service is furnished by a municipally owned utility. First, extensions and plant additions must be approved by the commission in certain cases; second, the financing of extensions within the city depends on the policy of the commission; and, third, extending service to those outside of the city is decided by the commission.

Unless there is a specified limitation of the service area, it is accepted that a municipally owned utility has an obligation to supply all applicants within the boundaries of the municipality under terms of a reasonable-extension rule. Many cities in Wisconsin consider mains to be improvements, the cost of which can be assessed against property on the basis of benefits. Statutes limit the assessment to 50 per cent of the cost of a main not more than 6 in. in diameter; street and alley crossings are usually excluded in determining such appraisals. The assessment is considered a tax and, as such, is not subject to the jurisdiction of the Public Service Commission.

* See Appendix A this issue, p. 969.

The policy of the commission on extensions within a municipality becomes important when the city is unwilling to make assessment for an extension or prefers not to assess the cost of mains. The commission has prepared suggested rules * that have formed the basis for the extension policy of most municipal utilities. If assessments are normally made, but the municipality is unwilling to do so, it is suggested that the water works construct the mains and require applicants to advance 50 per cent of the cost. Included in the rules is a provision for equalizing the advance if additional customers connect within 10 years. As most real estate developments are assessed by consent of the original owner, the rule is seldom applied.

The suggested rule where there has been no policy of assessment for main extensions grants to each applicant a free limit of 50 ft, which may be, and frequently is, expressed as a specific dollar investment to be made by the utility and, in a few cases, is given as a specified factor of the annual revenue. The applicant must advance 50 per cent of the cost of an extension in excess of the free limit, although there are equalizing adjustments upon connections of additional customers. The rule applicable to real estate developments where mains are placed in advance of the actual appearance of consumers may require the developer to advance the entire cost. A refund becomes available for each customer connected during the first 10 years.

Furnishing Service

Municipally owned water works have been authorized by Wisconsin statutes (Sec. 66.069 [2a] and Sec. 61.70 [2] †) to furnish service to persons or places outside of the corporate limits, including adjoining municipalities not owning or operating a similar utility. A recent addition to the statutes (Sec. 66.069 [2c] *) makes it possible for a village or city to fix the limits of service to unincorporated areas.

Utilities owned by municipalities have shown an increasing disinclination voluntarily to extend service beyond the corporate limits, even where the total cost of the extension is paid by the interested parties or a town sanitary district. The changing attitude of many water works and the Public Service Commission can be illustrated by the record of extensions outside of a large city. A sanitary district formed in 1938 in an adjoining town laid mains in its streets and asked that the municipally owned utility connect to those lines and furnish a supply to customers along the way. The request was promptly satisfied. After the sanitary district was enlarged in 1953 to include other areas in the same town, additional service was refused. A complaint was made to the Public Service Commission, which, after investigation and a public hearing, held that the city had no obligation. The commission's records show that the city has consistently provided water to those located within the area that the utility undertook to service. The concept of what constitutes the area or undertaking of service, however, has changed.

A complaint arose in 1948 from the refusal of the city to extend outside service to 27 lots owned by a contractor who wished to build houses. The locality was bounded on one side by the city, on one side by a sanitary district that was receiving city water under a plan similar to that proposed for the new section, and on the other

* See Appendix B this issue, p. 970.
† See Appendix A this issue, p. 969.

two sides by rural territory. The commission found that the municipally owned utility had to supply the new area under terms similar to those earlier made available to the adjacent district.

Early in 1954, the commission issued an order in connection with a complaint that the municipally owned utility had refused to extend service to a region similar to the one discussed above. The place for which service was requested had a common boundary with an outside area being furnished water by the utility. The commission found that the region under dispute was not within the utility's undertaking of service. The apparent change in the meaning of the phrase "undertaking of service" may be considered contingent upon the action of the legislature in giving to a municipality the power to define the limits of service outside of its borders. The commission stated in its findings in the 1954 order that the utility had no obligation to extend service prior to the time that the locality was made a part of the sanitary district (this step was taken after the action by the city council to establish limits beyond which the utility could refuse to extend service).

As an observer of the struggle going on along corporate borders, the author has formed a conviction that, under most circumstances where an area has developed to the point of desiring municipal service, such service should be obtained by annexation to the city. As a practical matter, because there is no means of compelling annexation and because the utility is a business undertaking, it appears that it would be wise to extend service as long as such a procedure is profitable.

Considerations other than the profit motive are usually present. Refusal or willingness to extend mains and service both have observable effects. Outside areas may be annexed to the city sooner if service is denied. On the other hand, an independent water utility is often set up adjacent to the central city, delaying annexation. Independent cities and villages have sometimes been organized to furnish the service. Such peripheral communities develop an appearance of permanence.

The extent to which the Public Service Commission will go in requiring extensions outside of the municipality is illustrated in cases before the commission in 1954. One dispute involves an urban development along a main highway just beyond the city. In 1939 the main was extended several hundred feet outside of the municipality and along the highway. The 1954 request for an extension to a greater distance was refused by the city council. The commission sustained this decision, finding that the utility had no further obligation. The total cost of the project would have been paid by the applicants.

In another case, a main was in place in a highway that followed municipal limits. The utility in the past had allowed outside customers to connect to the water main at their own expense, but permission was refused to the complainant, whose premises were beyond corporate boundaries but on a street in which a main was located. The commission found that the applicant was entitled to service and should be included within the utility's service undertaking. There had been no action by the municipality to define by ordinance the limits of the service area beyond the city.

The basis for the commission decisions, as stated in the opinion of the several orders, may be illustrated by a quotation from a recent case: "In the

absence of a specific delineation of the extent of the area outside of the city to be served, the commission must look to what the city, as a public water utility, has done for indications that will show its profession of service or undertaking so as to determine the extent thereof" (*2*).

Service in Larger Cities

There are 34 cities in Wisconsin with a population of at least 10,000. Five of the 34 utilities in such cities had rules on file for extension of service beyond the municipality. Seventeen water works had on file suburban rates higher than urban, while two utilities had equal rates for both areas. Fourteen of the nineteen cities where outside service was available had no extension rule, because outside extensions are no longer made or service is available only where property fronts on the city limits. Only four cities, two of which have privately owned water works, provide service to additional customers beyond the corporate limits.

Sewer Extensions

The problem of providing sewer service to suburban areas is frequently considered in connection with water main extensions. The jurisdiction of the commission with respect to sewer extensions is limited to a few fourth-class towns, villages, and cities that have, by ordinance, combined their water works and sewer plant or system into a single public utility. No questions involving service extensions have come before the commission during the relatively short time since limited jurisdiction over sewerage utilities was authorized in 1949. Sewer mains and lateral sewers are usually assessed against benefited property.

Sanitary Districts

Wisconsin statutes (Sec. 60.30 [1] *) provide for the establishment within towns of sanitary districts, which may operate a public water utility. In 1954, there were eighteen water works managed by sanitary districts, five of which were located in communities distant from urban centers and, therefore, served no part of a suburban area. The thirteen other sanitary districts, along with three town utilities, served approximately 10,800 customers and reported gross annual revenues of about $396,000.

As provided for in Wisconsin statutes (Sec. 60.31 *), three of the sanitary districts and one of the towns operating in suburban areas went out of business because the territory being supplied was annexed to an adjoining city. The districts and the town had been serving approximately 700 and 3,800 customers, respectively. After the 1954 annexations, there were ten water utilities of the sanitary districts and one under construction in the suburban localities. Two town utilities, both in the Green Bay area, were left. Because the water mains in the annexed sections had been laid in accordance with city specifications, assimilation into the municipal system was easy. The wells, however, were considered of only limited value to the larger water works.

Summary

Suburban water and sewer service is a problem concerning approximately 6 per cent of the urbanized population of Wisconsin. In the few communities served by private water companies, there has been no distinction between urban and suburban localities. The Public Service Commission has au-

* See Appendix A, this issue, p. 969.

thority to require a municipally owned utility to provide service to all applicants within the service area under terms of a reasonable extension rule. Although a municipality has the right to extend service outside of the city limits, many have refused to do so, and those that have are reluctant to go further. The commission has not opposed this trend. Of the 34 cities with a population of more than 10,000, only two with municipally owned supplies are now making extensions outside of corporate limits.

Extensions for real estate developments are facilitated under rules developed cooperatively by the utilities and the Public Service Commission. The latter has had no experience with the problem of sewer extensions except that furnished by new utilities which establish original service. Town sanitary districts and town water utilities have been used to a limited extent to provide a suburban supply.

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Sanitary Engineer Viewpoint—*Willard F. Shephard*

A paper presented by Willard F. Shepherd, Director, Div. of Eng., State Dept. of Health, Lansing, Mich.

From the author's viewpoint as a state sanitary engineer, the supply problem of suburban areas is essentially that of providing facilities that will compensate for the depreciation in existing supplies due to increasing population densities and of furnishing improved water facilities and services commensurate with the needs and resources of the community. Depreciation means the deterioration of the adequacy of supply as evaluated by criteria of quantity and quality.

A resident isolated from neighbors by considerable distances in most parts of Michigan can probably secure water in adequate quantity and at least tolerable quality by construction of an ordinary well. In such situations, the only concern of health agencies is to teach the householder to keep the well casing watertight and the opening at the top closed, to maintain a reasonable distance between the well and the toilet or barnyard, to use tight platforms, and to practice other safeguards. If he carries out such instructions—all of which are largely subject to his individual control—he, his family, and the community, insofar as he affects it, are reasonably well protected. A few near neighbors might not present too much hazard if everyone employs fairly good sense.

As more and more houses are being built and people begin to reside in rural sections, the problems of suburban areas start to develop. The difficulty may lie in an inadequate aquifer, the proximity of houses or other structures, a need for better fire protection, or the desire of individuals to reduce their work, a situation that often requires the use of large quantities of water. Because community action is vital, the outlying regions will provide a public water supply. Such undertakings can be done many ways under Michigan law. In fact, there are about eighteen statutes relating to

the matter in Michigan, and almost every legislative session enacts another or amends an existing one. All cities and villages have authority in their charters to furnish public water supplies, and private corporations can be created. If the area in question lies within an incorporated town, the difficulties of securing an adequate supply are usually not too acute.

Annexation

If the region is not part of such a city or village, the problem becomes considerably more complicated. One of the obvious answers is annexation to the nearby municipality. In Michigan this solution is not always easily accomplished because consideration of such a procedure becomes a matter of emotional rather than reasoned decision. When it is necessary (as it frequently is) to secure an affirmative consideration of the county board of supervisors and a favorable vote from the municipality to which the area is to be annexed, as well as from the people in the balance of the township to which the annexed area belonged, emotions can play a very significant role. Securing the successful culmination of such an undertaking can well become a time-consuming and frustrating task.

Subdivision Systems

The suburban area may organize itself as a township improvement district by appropriate petition to the township board. This method is also frequently used by property developers or land subdividers. The department of health has acquired considerable skill in inducing these persons to follow such a procedure, and they quite often agree to finance all of the expense involved in the construction of a water system if the township board will undertake the work.

Michigan law requires the state health commissioner to review plans and specifications for public water works systems and to issue a permit for such construction. This procedure applies to subdivision or township improvement district developments, as well as to the usual municipal installations. The health department protects the public health by adopting utility criteria that are not in the form of detailed published codes but, instead, constitute applications of fundamental principles in a manner that will assure attainment of the basic objective. The department receives substantial support from municipal water utilities that contract to furnish water to a suburban system. They sometimes insist upon the right to stipulate the standards to be maintained, which may be higher than state law demands. Townships are concerning themselves more often over the manner in which some subdivision supplies can be integrated into other parts of township systems.

It is, of course, entirely lawful for subdividers and land developers to construct their own systems. Numerous types of arrangements, including community cooperative ownership and management, have been resorted to for operating such installations. Michigan has had extremely unsatisfactory experiences with subdivision-owned water works, where the original subdivider vanished after his financial interest ceased, leaving the utility in the hands of unskilled, uninformed, and generally unwilling persons. Citing several such situations to developers and governing bodies effectively convinces them of the desirability of having water systems under some form of permanent and assured administrative control, usually, in Michigan, that of a governmental agency.

Cooperative Efforts

Suburban problems sometimes become more acute and vastly more complicated where local environmental conditions makes individual, small-community supplies impracticable, if not wholly impossible. It is essential for the smaller units to pool their efforts in developing a regional or district system.

Two types of procedures, which apparently have found favor in other states, do not seem to have great appeal in Michigan. One is the development of private water companies, which probably do not serve more than six sizeable municipalities. In these few cities, the water utilities are associated with electric utilities or local industry, to which providing the water supply is more or less incidental to other functions. The second procedure is the utilization of formal metropolitan district organizations. Michigan has only two and they serve relatively small populations; a third is presently being disbanded. None of the districts includes a large city as a nucleus, a situation usually found in other states. The limited use of such districts is probably caused by a peculiarity of organization mandatory under Michigan law.

Two other types of regional development seem to attract greater favor. One of these is the so-called "county plan," in which the board of supervisors declares by resolution its intent to establish a county water supply system and designates certain county officers to act as its agent. The board has authority to construct or acquire a water works and to enter into contract with other units of government for such purposes, as well as to issue revenue or general-obligation bonds. The municipalities may meet their obligations by a taxy levy, special assessment, rates for service, use of money received from imposition of taxes by the state, or application of other funds that could be validly used for such purposes. The county plan has been successful in Wayne County, and a very extensive addition to the system for service to new areas has been authorized and is planned for immediate construction.

Another way, created in 1952, is the so-called "water authority plan," under which the legislative bodies of two or more municipalities may incorporate an authority to build and operate water systems. Such an authority has the right to determine its functions and the extent of its services, to contract (for a period of not more than 50 years) for purchase and sale of water, and to issue revenue bonds to defray the cost of construction. A group of Oakland County communities lying just north of Detroit is using such a method to secure city water.

Financing Projects

The existence of several administrative procedures indicates that there are reasonably adequate legal methods of solving suburban water problems. Water works may be publicly financed by general obligation bonds, special assessments, appropriation from the general tax levy, bonds secured on revenues of such systems, and combinations of these methods. Except for revenue bonds, there are statutory or constitutional limits to the amount of public funds that can be raised for such purposes. Sufficient money can usually be secured, although the limitations of financial resources sometimes constitute very real obstacles.* The

* An example of how such obstacles may be overcome will be found in "Problems of New Water Utilities—South Adams County District" by J. H. Maguire, *Jour. AWWA*, Vol. 47, p. 88 (Feb. 1955)—*Editor.*

period between the inception of vigorous expansion and the achievement of substantially full development can be exceedingly difficult to meet financially. Under present circumstances, this fact sometimes requires a very careful coordination of the construction and financial plans, because Michigan does not provide monetary aid. There has been some thought that it might be appropriate for the state to underwrite certain projects through the initial period by some form of bond insurance. Such a course would need to be very carefully circumscribed to provide help only in appropriate instances and under controllable conditions. A "grant in aid" program is not contemplated.

The procedures presented in this paper are the reasonably adequate tools that are available to Michigan suburban areas and the health department for solving the problems raised by the metamorphosis from rural to urban culture. Construction of utilities at an appropriate time can take place only through an effective integration of many factors, such as health, safety, profit, convenience, local pride, and strong local leadership, together with law enforcement procedures where necessary. The earnest and effective cooperation at all levels of government is required. Utilization of all of the various media of communication—newspapers, radio, television, town meetings, pamphlets, posters, demonstrations, models, art displays, and service clubs—is also essential. The most important factor is plain hard work.

Fire Protection—*Kenneth J. Carl*

A paper presented by Kenneth J. Carl, Engr., National Board of Fire Underwriters, New York, N.Y.

The rapid expansion of the United States in the past decade has resulted in the development and growth of many suburban communities. The first of these is the isolated district that requires entirely new facilities and services. The second is the new neighborhood built on vacant land within the limits of an established municipality, necessitating an extension of existing facilities and services. As land develops within a city, there is usually a similar development immediately outside of it, where dependence is usually placed on the municipality for at least some of the needed service. The third type is the locality that has been acquired by annexation. Such areas place the greatest burden on a municipality because they are entitled to service comparable to that of the rest of the city and very often possess few facilities of their own.

General Problem

In approaching the fire protection problem in such suburban localities, the water supply phase is naturally of primary interest to water supply engineers. It should be recognized, however, that there are other essential aspects. In the first place, the character of the areas served—whether industrial, mercantile, or residential—the size, type, and spacing of buildings, and the general overall layout are of considerable importance. Where adequate zoning ordinances and building codes are not provided to guide and control the growth of expanding communities, heterogeneous patterns and congested groups of buildings develop

that make the task of providing adequate fire protection more difficult.

Also deserving of consideration is the fire department, one of whose important functions is to prevent fires. It can do this effectively only if a good fire prevention ordinance has been enacted and is being enforced by a special bureau within the department. When fires do occur, it is charged with the responsibility of saving lives and keeping property losses to a minimum by as quick extinguishment as possible. Because water is the principal extinguishing medium, an adequate supply is essential to the effective utilization of the manpower and equipment of a fire department.

Supply Requirement

Many persons wonder if the water carried in booster tanks on fire department pumpers or in special tank trucks is not sufficient for suburban areas. These supplies are certainly of some value and, in strictly rural areas with scattered dwellings, they may be the only practical type. In suburban localities, however, where buildings are grouped together and often form entire communities with schools, churches, recreational centers, and mercantile districts, a conventional water supply system provided with hydrants is necessary for adequate fire protection.

Perhaps the importance attached to the provision of a good water system in a suburban section can best be illustrated by comparing fire insurance rates in areas where such installations exist and in localities where the only water available for fire fighting is that carried in tanks on fire department apparatus. Inasmuch as the National Board of Fire Underwriters (NBFU) does not promulgate fire insurance rates and does not have any data on this subject, the information that follows was obtained from the New York Fire Insurance Rating Organization, which is responsible for establishing rates in New York State under the supervision of the superintendent of insurance.

In suburban areas with an approved public water supply system and an organized fire department, the annual fire insurance rate per $100 of insurance on "frame private dwelling buildings" is 12 cents. If a water system is not available and dependence is placed on the tanks of fire department apparatus, the rate is 24 cents if the property is located within 3 miles of the fire station in the district. In one suburb that had an organized fire department but no public water system, relying entirely on the tanks of fire department apparatus, the appointment of a full-paid fire chief was being considered.

When asked what the effect of such an appointment might have on fire insurance rates, the New York Fire Insurance Rating Organization suggested that consideration be given to the installation of a public water system before the appointment of a full-paid chief because the former could justify a reduction in rates whereas the latter could not.

General Requirements

Where it is necessary to develop an entirely new water supply system for a suburban area, the "Standard Schedule for Grading Cities and Towns of the United States With Reference to Their Fire Defenses and Physical Conditions" (*1*) should be used as a guide in providing adequate fire protection.

The required fire flow for the principal business district in the average

municipality is obtained by the use of the formula:

$$G = 1{,}020\sqrt{P}\ \ (1 - 0.01\sqrt{P}),$$

where G is the required fire flow in gallons per minute and P is the population in thousands. The flow may be increased or decreased in accordance with structural conditions and degree of congestion. In many new suburban areas, the fire flow indicated by the formula will be reduced because there are a number of small scattered business districts instead of a single large one. Where buildings, such as supermarkets, have excessive area, the fire flow indicated by the formula (or perhaps even more) will be needed because of the large amount of combustible material that may be under one roof. Where suburbs contain industrial, institutional, or other sections that require fire flows in excess of that necessary for the principal business district, the highest required fire flow should govern the design. Fire flows of 1,000 gpm should be available for 4 hr, the duration increasing with larger fire flows up to a maximum of 10 hr for 2,500 gpm or more.

The required fire flow for residential districts consisting of small-area, one-family dwellings one or two stories in height varies from 500 to 2,000 gpm for 2–4 hr, depending on the degree of exposure between buildings.

In order to provide an adequate supply, the system should be capable of delivering the maximum fire flow required for the specified duration with consumption at the maximum daily rate. To meet this requirement the capacity of the supply works can be made equal to the maximum daily consumption rate and sufficient storage can be provided on the distribution system to deliver the required fire flow.

Reserve Capacity

It is obvious that some reserve capacity should be available in the supply works. Those dependent on pumps should be capable of delivering the required fire flow for the specified time during a 5-day period with consumption at the maximum daily rate and any two pumps out of service. The 5 days allowed for the repair of pumping equipment appears very conservative in view of the recent experience of a village in New York State. The largest unit, 5,000 gpm, failed because of a burned-out motor on May 20 and was not restored to service until June 3. The repair work was expedited in every way possible because restrictions on water use had to be instituted during the emergency.

The reliability of electric power supply is another factor that should be given careful consideration. Power sources, transmission lines, transformers, switches, and other equipment should be installed so that a break in a line or the failure of a single unit will not prevent the delivery of the required fire flow for the specified period at any time during two days with consumption at the maximum daily rate. Standby electric generators and pumping units or auxiliary drives on pumps are of great value in offsetting the effects of electric power failures.

Distribution System

In designing the distribution layout for a new water supply system, a splendid opportunity is presented to provide adequate flows for domestic and fire use in all areas. No limitations are imposed by small arteries or

feeder mains or an already weak gridiron, unfortunate situations that frequently affect extensions of existing systems. The mains supplying hydrants should be at least 6 in. In fact, because of the peak loads of recent years, it is very doubtful if smaller sizes should be used for any portion of the distribution system. The minor distributors should be interconnected with mains of equal or larger size at intervals of 600 ft, and, where pressure is high, these may be increased.

In many new developments, the streets are curved, the distances between intersections are long, and the general arrangement of blocks and streets is such that the regular-interval interconnection of minor distributors is not feasible. Their layout, therefore, takes on a much different appearance than the typical rectangular gridiron pattern that has been used for many years in most distribution systems. A greater proportion of 8-in. mains is necessary to strengthen the system adequately. Dead ends, of course, should be avoided wherever possible, but if used, the minimum size main should be 8 in.

The arterial mains in such new developments should be at least 12 in. in diameter and arranged in loops extending throughout the area served. In order effectively to utilize the full potential of these lines, they should be connected to all minor distributors that cross their routes. Storage provided on the distribution system should not be located at the pumping station, but should be placed on the opposite side of the points of maximum demand and should be connected to an arterial loop. The storage may be in elevated tanks or may be in ground level tanks as suction supply for pumps discharging into the distribution system, but particular care should be taken in the latter type to provide reliability of pumping capacity and power supply.

Hydrants and Valves

Because the water used by the fire department must be taken from the distribution system by hydrants, it is important to see that they are of satisfactory size and are well distributed. They should meet AWWA specifications (*2*) and should be installed with at least a 6-in. gated connection to the street main in such a way that the friction loss between the main and hydrant outlet will not exceed 5 psi for a discharge of 600 gpm. In the residential portions of new developments, where the required fire flow may range from 500 to 2,000 gpm, the average area served by each hydrant should not exceed 110,000 sq ft. Hydrants at street intersections are generally of greater value than those at intermediate points because hose lines can usually be laid from the former in four directions. It is good practice, therefore, to place at least one hydrant at each intersection and to supplement these by sufficient hydrants at intermediate points to meet the requirements of service. For many distribution systems, a useful rule of thumb to obtain good spacing is to place a hydrant at each intersection and other hydrants at intermediate locations so that the intervening distances do not exceed 500 ft. In business, industrial, institutional, and other important areas, additional hydrants will generally be needed to deliver the greater fire flows required.

In order to minimize the effects of breaks or other emergencies which may cause parts of the system to be removed from service, a sufficient number of gate valves should be provided. For new residential areas, the shutoff length (length of main that must be shut off to isolate a break) should not

generally exceed two blocks, or 800 ft. In business or industrial districts, this maximum should be reduced to 500 ft. Each municipal fire protection survey made by NBFU includes a careful study of gate valve spacing. These studies have sometimes revealed unusually long shutoff lengths, a situation of which even the superintendent was unaware. Such conditions usually arise from employing a fixed distance between valves as a standard instead of a definite shutoff length.

Consumption Rates

In Nassau County, located on Long Island, N.Y., many new communities have sprung up in a few years on what was formerly farmland. The growth of these localities has usually entailed the design and installation of entirely new water systems, which obtain their supply from wells provided with deep well pumps that discharge into the distribution systems. These generally have some storage in elevated tanks. In the summer, when the peak loads caused by lawn sprinkling during the early evening hours may exceed six times the average daily consumption rate, many of the elevated tanks are emptied and pressures seriously reduced. In considering the magnitude of these peak rates, it should be realized that the areas under discussion are recent developments with new lawns and that the amount of water used for lawn sprinkling will be somewhat greater than in long-established communities. In one such older town in New Jersey, however, rates as high as five times the average daily rate have been recorded.

In the design of water supply systems, the peak hourly rate has been taken for many years as 150 per cent of the maximum daily consumption rate, and the latter has been taken as 150 per cent of the average daily consumption rate. These relative factors, which give a peak hourly rate of 225 per cent of the average daily rate, still hold true for most of the larger eastern cities but are generally exceeded in many western cities and in most small municipalities. In designing a system, the maximum delivery rate is controlled either by the peak hourly rate or the required fire flow plus the maximum daily consumption rate. If the average water use is considered to be 100 gpcd, the peak hourly rate based on the conservative factors previously mentioned is equal to the fire flow plus the maximum daily consumption rate for a city of about 200,000. If the present accepted average of 140 gpcd is used, these two rates become equal at a population of about 150,000, indicating that the peak hourly rate now controls the design for more cities than formerly, because of the increase in per capita consumption. If the higher relative factors for peak hourly consumption now prevalent in many municipalities are considered, it is evident that even more cities will be included in this category.

In the new small communities and in the suburban areas of large cities, it has already been stated that peak hourly rates may exceed six times the average daily rate. This means that the peak hourly rate rather than the fire flow plus the maximum daily consumption rate should control the design, a fact that has been demonstrated in the results of fire flow tests made in a number of new communities. The systems were found to be capable of delivering the maximum daily consumption rate plus fire flow, but they have failed to meet peak hourly rates. In one area, the average daily consumption was 3.30 mgd, the maximum daily consumption was 8.12 mgd, and

the maximum required fire flow was 5.76 mgd (4,000 gpm). The system was capable of meeting the maximum daily consumption rate plus fire flow (8.12 mgd plus 5.76 mgd equals 13.88 mgd) but could not meet the peak hourly rate, which was somewhat more than 16 mgd, or about five times the average daily rate.

System Extensions

All that has been mentioned concerning distribution for new water supply systems applies equally well to extensions of existing systems. There is, however, a tendency to keep on adding without developing an overall plan. Many outlying areas are furnished water merely by adding mains to the existing gridiron without providing any large feeders or further arterial strength for the older portion of the system from which the new mains are supplied. Such practices result in poor fire protection and peak demand service in recently developed localities.

In supplying suburban areas by means of extensions from existing systems, some departments have made extensive use of 2-in. pipe supplied at wide intervals by 6- or 8-in. pipe. This type of installation, undoubtedly prompted by economy, has usually resulted in poor fire protection. The effect of such a small size can best be illustrated by a comparison of two portions of the distribution system of a moderate-size southeastern city. The distribution grid in the older portion consists mainly of 6-in. and 8-in. pipe. The blocks are 500 ft by 900 ft, with the 6-in. mains running along the larger dimensions. A hydrant is provided at all but a few intersections, as well as at intermediate points on the long side of most blocks. In the newer section of the city the blocks are the same size and shape, but the distribution grid consists of 6-in. mains every two blocks, or 1,800 ft, joined by 2-in. lines which are in the streets 500 ft apart. A hydrant is located at each intersection on the streets containing the 6-in. pipe, but none are placed elsewhere because of the low capacity of 2-in. pipe. The average area served is 508,000 sq ft per hydrant, which is excessively wide and about double that in older districts. It is interesting to note that in grading hydrant distribution under the "Standard Schedule" (*1*), the deficiency charged in the new area would be 75 points greater than that for the old. The city cited above no longer uses 2-in. pipe in the distribution system, and all developers are required to lay lines at least 6 in. in diameter.

Extensions into new areas of many municipalities consist of single mains along principal highways radiating from the major portion of the distribution system like spokes from the hub of a wheel. The general practice has been to use 6- or 8-in. pipe for such installations. Later, when groups of dwellings extending several blocks on either side of the highways are built, the supply for the small gridirons serving these localities is taken from the original single line. It is obvious that such small mains are not adequate, a fact that has been frequently illustrated by fire flow tests made in many recent municipal fire protection surveys. As a general rule, the single mains should not be less than 12-in. in diameter. As the spaces between the "spokes" continue to develop, these feeders should be connected by additional mains at least 12 in. in diameter, to supply the minor distributors of the gridiron. Wherever practicable, other lines should extend from the original distribution system to provide additional

"spokes." Storage, frequently used to good advantage in such systems, may be the only way to assure reliability where topography prevents the interconnection of the "spokes."

The growth of the United States presents a challenge to every industry, including water utilities, whose burden is particularly great. Demand for water is increasing throughout the country, especially in new suburban areas. The water works must accept the responsibility for these new areas and provide them with adequate supplies for domestic use and fire protection.

References

1. *Standard Schedule for Grading Cities and Towns of the United States.* Natl. Board of Fire Underwriters, New York (1942); *Jour. AWWA,* **34**: *following* p. 1584 (Oct. 1942).
2. Standard Specifications for Fire Hydrants for Ordinary Water Works Service—AWWA C502. Am. Wtr. Wks. Assn., New York (1954).

Resume—*Abel Wolman*

A recapitulation by Abel Wolman, Prof. of San. Eng., Johns Hopkins University, Baltimore, Md.

John C. Hazeltine has made it clear that the US Housing and Home Finance Agency has a responsibility for facilitating and speeding the building of houses in the United States. In a sense, the agency is the creator of the problems of the water utilities, because it is making the construction and purchase of homes financially possible for many more families than ever before in history. Such wholesale building causes shortages in community facilities. These should be anticipated in advance planning. The federal government has made modest sums of money available for such work, and the funds for this activity will probably increase in the future. They are reimbursable and, after municipalities and suburban areas have had the opportunity to prepare suitable designs, the loan is returned to the agency for further use.

Orville P. Deuel has made the very important point that in the enlightened state of Wisconsin, with its long history of Public Service Commission control over both private and public operations, a number of ways of meeting demands for more water have been devised. One such procedure removes a disability of the privately owned utility. This method uses the general tax obligation of the community in addition to the private utility revenue as a basis for financing mains and providing service. One of the deficiencies or weaknesses of many privately owned utilities is that new systems often do not have sufficient customers early enough to pay for the development. The employment of the general tax obligation is a very sound principle of financing. The Public Service Commission has also been able to suggest various other ways of advancing into areas that need to be opened with a fair degree of speed.

Willard F. Shephard pointed out the variety of ways, with some of their disabilities and weaknesses, that are in use in Michigan for providing suburban facilties. He said that certain methods are frowned on in this state, although they work very well in Wisconsin. One of the interesting aspects of the United States, with its broad geographic and psychologic complexities, is that what is acceptable in one county sometimes is wholly undesirable

in an adjacent area. This situation, a challenge to improvisation, means that there are multiple answers to the problems of suburban localities. A series of such solutions were presented, and six or seven of them were outlined.

There are virtually no states other than Virginia (and, perhaps, one more) that have annexation laws that substitute an orderly judicial procedure for the emotional approach. The junction is made successful by court hearings and decisions, which rest, if not on love, on law at least. Since its legislation on the matter, Virginia has had more annexations than, perhaps, any other state, a situation attributed to the fact that it is an intelligent, orderly process.

It is possible for a central city to be the purveyor of water for the adjacent localities without headaches or loss of money and with a reasonably clear policy on physical administration. For example, Baltimore supplies 250,000 persons beyond corporate limits in three counties. This undertaking is not carried out at a loss, and service will be expanded in the future. All of the city's planning, designs, construction, and physical policies are related to the entire metropolitan area and not to only the central core.

Kenneth J. Carl has made it clear that the water works industry is confronted with problems of design, financial policy, administration, and political structure. Utilities are confronted with the necessity of reorienting the designs of their systems because personal habits have changed in the United States, as well as in other countries. For example, water consumption in England rose from 49 to 51 gpcd, causing a great deal of inquiry and Parliamentary investigation. In the United States, consumption has climbed, in some areas, from 100 to 140 gpcd and, in Baltimore, to 190 gpcd without legislative probings. When it is certain that the increase represents legitimate uses and a change in desires, procedures, and customs, water utilities must supply the service, but without loss or financial jeopardy.

Water works must adjust their standard designs because they are no longer applicable to present-day service. The way of life has changed, and the number of gadgets used in each house is steadily increasing. The fact that they can be bought on an installment plan is an extraordinary American characteristic. It is a waste of time to say: "You should not put in the disposal units; you should not put in a dishwasher; and you ought not to have a washing machine." Instead, the energy that such fruitless efforts would take should be put into designing, building, and paying for modern installations.

Water works management has always taken pride in providing service, but it seems that the justification for such an attitude is gradually disappearing. People are saying that the wintertime service is more than is needed, but the summertime supply is scanty. Such a situation is not considered good service, and no amount of propaganda is going to make persons think differently. Certainly, the rationing that has taken place in many communities for the past decade was not good service.

It is the present author's belief that the subdivider cannot take over the function of public responsibility for community facilities. Many areas in the United States which need medium-

priced houses, at about $8,000 each, provide for community facilities by using the subdivider as the banker, who must raise the selling price to $9,000 or $10,000. The extra cost represents, of course, sewerage, schools, and other facilities in addition to water supply. Subdividers are in business to furnish housing, and it is the water utilities' business to see to it that water supply service is provided for this housing.

APPENDIX A

Excerpts From Wisconsin Statutes on Extensions and Sanitary Districts

Sec. 62.19 (1)—*Assessment.* When the council shall have ordered the laying of any water or heat main, forming a part of a plant owned by the city or a part of a plant owned by a private utility where such utility has a written contract in effect with such city for the laying of mains on order of the council, the board of public works shall, before laying the same, make an assessment upon the property benefited as provided in this section.

Sec. 66.069 (2)—*Outside service.*

(a) Any town, town sanitary district, village, or city owning water, light, or power plant or equipment may serve persons or places outside its corporate limits, including adjoining municipalities not owning or operating a similar utility, and may interconnect with another municipality, whether contiguous or not, and for such purposes may use equipment owned by such other municipality.

(b) So much of such plant or equipment, except water plant or equipment or interconnection property in any municipality so interconnected, as shall be situated in another municipality shall be taxable in such other municipality pursuant to the provisions of Sec. 76.01 to 76.29.

(c) Each village or city shall by ordinance fix the limits of such service in unincorporated areas.

Sec. 60.30 (1)—*Town sanitary districts; definition, purposes.* Town sanitary districts may be created for the purpose of purchasing, establishing or constructing surface or storm water sewers, drainage improvements, sanitary sewers, or a system or systems of water works, sewerage, garbage, or refuse disposal or all of such improvements or any combination thereof, within a town or towns or portions thereof; and to that end may sue and be sued. The definitions in Sec. 144.01 are applicable hereto. A sanitary district may sell any of its services to users outside its corporate limits. The term "sewerage" as used in Sec. 60.30 to 60.309 shall be considered a comprehensive word, including all constructions for collection, transportation, pumping, treatment and final disposition of sewage.

Sec. 60.31—*Alteration of sanitary districts.*

(1) (a) When any territory which includes an entire town sanitary district shall be incorporated as a city or village, or when such territory shall be annexed to any city or village, such sanitary district shall thereupon be dissolved. In the case of situations described in Subsec. (1) (a) which have already occurred, the sanitary district shall be dissolved Jun. 12, 1951. All acts of the sanitary district commission occurring before Jun. 12, 1951, are hereby validated.

(b) The property of such district shall pass to the city or village and all assets and liabilities of any such district shall be assumed by such city or village. If any mortgage bonds or mortgage certificates are outstanding, the transfer of the property shall be subject to such bonds

or certificates. If any general obligation bonds are outstanding, the city or village shall cause to be levied and collected upon all taxable property in such city or village in one sum or in annual installments and irrepealable tax in an amount necessary to pay the interest and principal of such bonds when due.

(c) Special assessments levied by the former district shall continue to be collected by the city or village, and shall be applied to the purpose for which the original assessment was made.

(2) (a) When any territory which includes less than an entire town sanitary district shall be incorporated as a city or village or when such territory shall be annexed to a city or village, then paragraphs (b) and (c) shall apply as of the date of incorporation or annexation as to future incorporations and annexations and as of Jun. 12, 1951, as to incorporations or annexations which have previously occurred.

(b) There shall be a division of assets and liabilities in accordance with Sec. 66.03, except that the ownership of any water or sewerage system shall be determined as provided by (c) of this subsection.

(c) Any water or sewerage system, including all mains and all property of the system, shall belong to and be operated by the sanitary district or the city or village, in whichever the major portion of the patrons shall reside on the date specified in (a), unless other provision shall be made by agreement of the governing body of the city or village and the sanitary district commission. Express power is hereby granted to the governing body of the city or village and the sanitary district commission to contract with each other relative to the operation and property of any water or sewerage system. Special assessments levied theretofore shall continue to be collected by the district or city or village which is operating the facilities and shall be applied to the purpose for which the original assessment was made.

(d) In determining the major portion of the patrons, each location served shall be considered as one patron irrespective of the manner in which the title to the property may be held.

(e) When the responsibility for continuing the operation is vested in the sanitary district, it shall continue, except by agreement, until the proportion of users changes so that a majority of the patrons shall reside in the city or village, at which time the property and the responsibility shall shift to the city or village.

(3) No city or village which secures a system pursuant to Sec. 60.31 shall be required to serve an area outside its corporate limits greater than that included in the district at the time of annexation or incorporation, but shall continue to serve the area previously included within the sanitary district.

Sec. 61.70 (2) Where the village owns or operates water works, the village board may contract to furnish water for fire, mechanical and domestic use beyond the village limits and to lay the necessary pipes, mains, and conduits for that purpose.

APPENDIX B

Wisconsin Public Service Commission Extension Rules

The following rules are suggested for use where mains are normally laid at the utility's expense:

The ..... Water Department will extend water mains for new customers and will decide whether the extension is to be 6 in. where fire protection service is needed, or 2 in. as a minimum size or larger where no general fire protection is needed.

Definitions

Customer. The word "customer" as used in this rule means the owner of premises to which water is furnished or is to be furnished, unless specific written agreements specify otherwise. The customer at all times means the customer at the time a contribution is to be made or a refund becomes available.

Contributor. Contributor means the owner of property at time of a contribution or a refund, unless otherwise specified by written agreement.

Free Limit. One-half of the average cost of 50 ft of main in any extension where 6-in. or larger main is used and 100 ft of the average cost of 2-in. or larger main used for general service only.

Determining Contributions

The entire cost of the extension, including fire hydrants where set, and street intersections will be computed and one-half of the total allocated to general service, where fire protection is furnished. All of the cost will be allocated to general service where there is no fire protection service. The free limit in dollars as determined (see above definition) times the number of customers is then deducted from the amount allocated to general service. The balance of the cost of extending general service will be financed by the applicants for service.

Refunds

When additional customers are connected to a water main that was paid for in part by customers, the utility will refund to the contributors, not including the new customers, one free limit for each new customer. The new customer shall then pay a connection charge equal to the average remaining contribution in the extension. This connection charge will then be refunded pro rata to all contributors, including the new customer.

Extension Limit

When an extension beyond an existing extension is required to serve a new customer, and the cost, after crediting the free limit, exceeds the average remaining contribution in the original extension, the additional extension will be classed as an entirely new extension.

Refund Limits

The period during which refunds will be made will be limited to 10 years from the time that the first customer is connected to an extension. In no case will the total amount refunded exceed the contribution.

The following rules are suggested for use where assessments are normally made against main extensions.

The ..... Water Department will extend water mains for new customers and will decide whether the extension is to be 6-in. or larger pipe where fire protection service is needed, or 2-in. pipe as a minimum size or larger where only general service is needed, on the following bases:

A. Where the cost of the extension is to be immediately assessed against the abutting property, the procedure set forth under Sec. 62.19 of the Wisconsin Statutes will apply.

B. Where density of prospective consumers does not warrant immediate assessment for the mains, extensions will be made on a customer-financed basis as follows:

Definitions

Customer. The word "customer" as used in this rule means the owner of premises to which water is or is to be furnished, unless specific written agreements specify otherwise. The customer at all times means the property owner at the time a contribution is to be made or a refund becomes available.

Contributor. Contributor means the owner of property at time of a contribu-

tion or refund, unless otherwise specified by written agreement.

Determining Contributions

The entire cost of the extension, including fire hydrants where set, and street intersections will be computed and one-half of the total allocated to general service where a fire protection service is furnished. The entire cost will be allocated to general service where there is no fire protection service. This amount will be financed by the applicants for service.

Refunds

When additional customers are connected to a water main that was originally financed in part by customers, the utility will require a contribution from each new customer equal to the existing average contribution. When the amount of customer contribution computed under *B* is less than would have been assessed under *A* above, the applicant for service shall pay the assessment. This amount shall then be refunded pro rata to all contributors along the extension whose remaining contribution still exceeds what would have been assessed under *A* above.

When refunds have reduced the contribution of any contributor to the point where his contribution equals the amount that would have been assessed under *A* above, no further refund will be made to that individual. After all refunds have been made, the remaining premises that may connect will be assessed at the computed amount (under *A* above) per front foot abutting the main.

Extension Limit

When an extension beyond an existing extension is required to serve a new customer, and the cost per customer exceeds the average remaining contribution in the original extension, then the new extension will be considered as an entirely new project, without refunds or other connection with the original extension.

C. When customers connect to a transmission main or connecting loops laid at utility expense, there will be assessed on a front foot basis an amount equal to the average front foot assessment in the area.

Need for Water Management Program in Industry

K. S. Watson

A paper presented on Jun. 14, 1955, at the Annual Conference, Chicago, Ill., by K. S. Watson, Consultant, Water Management & Waste Control, General Electric Co., Schenectady, N.Y.

THE surface water network of the United States is probably the nation's most valuable natural resource. It does not take much thought to realize that water plays the most vital role in mankind's individual, industrial, and municipal enterprises. Water of proper quality in adequate amounts is of great importance in the operation and growth of industry, which requires considerably more water than the population of urban areas. At present, the water utilities serve more than 100,000,000 persons an average of 140 gpd, totaling 14 bgd (*1*). The US Geological Survey estimates that industry requires 75 bgd from surface streams and 6 bgd from wells (*1*). In addition, 80 bgd is needed for irrigation (*2*).

A failure of the seemingly inexhaustible water furnished by water works can close down an industrial plant just as surely as a stoppage in the supply of coal or electricity. Perhaps a clearer concept of the value of water may be gained upon realization that it takes 50,000 gal to make a ton of steel, 39,000 gal to produce a ton of paper, 140,000 gal to manufacture a ton of woolen cloth, and 80,000 gal to produce 1,000 kwhr of electrical current in a steam generation plant (*3, 4*). Investigation will confirm the fact that water is required in the production of practically all the things everyone uses and depends upon.

There are definite, disturbing indications that the water resources of the nation are not inexhaustible. Six per cent of the public water supplies serving more than 1,000 communities in the United States are unable to meet peak demands (*5*). Recent droughts have plagued many sections of the nation. Water shortages occurred in 60 communities in Ohio during the summers of 1953 and 1954, and the problem continued through the winter in some localities. Drought conditions in Illinois in recent years have been the most serious on record, with sixteen major communities having to take emergency measures to bolster dwindling water supplies. Such conditions tend to confirm the vital importance of water in the large population concentrations of the nation.

Many consumers depend on wells and springs, but the ground water table has even greater limitations on its yield than the surface water network, a fact borne out by the great number of localized areas in which the water table has drastically fallen and continues to fall. Encroachment of

salt water in coastal areas also attests that ground water can be seriously depleted.

The limitations of water supply and the shortages now occurring make it even more apparent that industries and municipalities alike have a grave responsibility for developing sound water usage practices to protect and preserve the nation's vital water resources.

Philosophy for Water Use

Close association with all types of water supply for many years and direct contact with industrial water supply in recent years has convinced the author that there is a sound philosophy of water use for industry which is consistent with its production capabilities. As a result of the industrialization and urbanization accompanying the atomic age, no one can any longer take adequacy of water supply for granted, a fact that is true of industry, as well as of municipalities and private citizens. Industrial plants and companies that require large volumes of process water must realize that industries and municipalities are continually expanding, but that the quantity of water available for ultimate use is not growing accordingly. More water could be obtained, perhaps, by going deeper into the earth or by running a line to a stream at greater distance, but such procedures merely tap another portion of the nation's water reserves, the ultimate yield of which is a relatively fixed amount.

The only realistic approach to the water supply problem of industry is a determination to use water in such a manner that it will not be wasted. The water management program should be integrated with a concern for best use of the water, from its source, through all the plant processes, to the discharge of an effluent that does not injure the receiving stream for others. Industry should realize that water supply and industrial wastes control are irrevocably tied together. The first and soundest step in engineering industrial wastes control is to plan realistically for water requirements and use. It is often quite possible to achieve large cost reductions in addition to simplifying the industrial wastes problem. The water management program envisioned by the author should be concerned with encouraging each plant to:

1. Make sure it is using the best source of water available, from the standpoint of quantity, quality, and cost; a sound water supply should be a factor in the selection of sites for new plants.
2. Be sure that adequate amounts of the water are softened, deionized, or otherwise conditioned, where justified, for any special plant use.
3. Practice the conservation of water and its recirculation and reuse where economical; in some localities where water is in short supply, such procedures will be the only means of insuring sufficient water.
4. Define the plant waste problem and introduce—within the plant and without treatment—steps consistent with economy to correct the problem; if a waste problem still exists after such action, it will at least have been reduced to an absolute minimum.
5. Provide waste treatment where required by the character of the remaining wastes and the receiving stream or sewer; such a step is good citizenship by the plant in promoting the general welfare through protection of community water resources.

Nothing serious will be done about water management until someone is given responsibility for it. In plants that consume large volumes of water, personnel who have full-time jobs cannot do justice to water management as an additional duty. If the plant uses a considerable amount of water, a start could be made by having one man establish the parameters of plant consumption. The decision about staffing the water management area properly should come next. If the man first assigned to the field of water management has had previous water and industrial waste experience, his work will be easier and results will be more immediate. He need not worry about his job being temporary, because it has been demonstrated that someone must be kept constantly on watch or the gains made will be lost.

Company Program

Because the General Electric Co. is a large user of water and has long recognized that the welfare of the nation, the company, and other large industries, as well, are directly related, it began gathering a staff in 1950 to make sure that the water was given proper handling in the individual plants. Considerable progress has been made in the program of water management, and survey activities have indicated the areas in which future efforts will be most productive. The experiences of the author's company will be outlined to show that water management within a plan is a step toward the preservation of the nation's water resources, and can be responsible for considerable cost reductions.

TABLE 1

Water Consumption and Cost by Operating Groups, 1953

Group	Consumption—gal		Costs	
	Per Day	Per Year	Per Year $	Per 1,000 Gal* ¢
Apparatus	53,538,000	16,252,985,000	959,930	10.5
Appliance and electronics	17,288,300	3,784,237,000	605,348	15.2
Industrial products and lamp	34,343,700	9,786,961,000	865,399	13.7
Defense products	4,220,100	1,231,738,000	228,711	19.3
Total	109,390,100	31,055,921,000	2,659,388	

* Costs per 1,000 gal are for water taken from municipal systems only; costs of plant-developed sources are excluded.

Evaluating Water Use

A basic step in water management is that of evaluating and summarizing water consumption and cost figures, a procedure routinely done by the General Electric Co. Its 132 plants consumed 31.06 bil gal during 1953 at a cost of $2,659,388. Table 1 shows water consumption and cost figures for each of the company operating groups. It will be noted that the apparatus group consumed about 52.3 per cent and the industrial products and lamp group about 31.5 per cent of

the water. The average cost of water taken from city systems ranged between 10½ and 19½ cents per 1,000 gal for all the groups. The average cost for water from public systems was 13⅞ cents per 1,000 gal.

Table 2 presents consumption and cost figures for plants of various sizes. It will be noted that the company has fifteen plants which take more than 1,000,000 gpd from a public water system and that 33 plants draw less than 50,000 gpd from such a supply. As shown in Table 3, only sixteen plants use plant-developed sources of supply, seven of which are wells, and nine of which are streams. There are five plants with private sources consuming over 1 mgd. About 50 per cent of the company's water is derived from nonpublic sources. Some of the plants with such supplies are also connected to a city system.

Water taken from plant-developed wells costs 3.7 cents per 1,000 gal, including depreciation of the installation. Stream water treated only by chlorination costs 3.9 cents per 1,000 gal, including depreciation. It is obvious that water from a private source is cheaper than that procured from a municipality. In the company's only treatment plant, it costs 8.6 cents per 1,000 gal to produce process water.

TABLE 2

Consumption and Cost of Water From Municipal Sources, 1953

Consumption *gpd*	Number Of Plants	Total Yearly Consumption *gal*	Costs	
			Per Year $	Per 1,000 Gal* ¢
Less than 50,000	33	117,581,000	30,144	25.6
50,000—100,000	15	268,935,000	55,901	20.8
100,000—250,000	34	1,637,757,000	258,632	15.8
250,000—500,000	18	1,661,490,000	227,813	13.7
500,000—1,000,000	9	1,565,820,000	225,339	14.4
Over 1,000,000	15	10,165,041,000	1,315,121	12.9
Total	124	15,416,624,000	2,112,950	

* The cost per 1,000 gal is the weighted average cost of water for all plants within the category, excluding plant-developed supplies; one new plant was excluded because of insufficient operating experience.

Conservation

In the water management program of General Electric Co., the act of conservation is construed to mean reducing water requirements without special, costly equipment. One of the simplest and most effective conservation steps is that of installing meters. These measuring devices permit operating personnel to become familiar with the quantity of water being used for any particular operation. After the meter is in place, the next step is to set and attempt to attain a realistic conservation goal.

A meter will readily show how much water is being wasted when the manufacturing machines are not in operation. After a meter had been installed in a building of one plant and a conservation program had been in effect, consumption was decidedly lowered during Saturday and Sunday. A defi-

nite reduction also took place on the second and third shifts, when the plant was not in operation. The water requirements for the first, or manufacturing shift, were greatly lessened.

Another way of saving water is to provide automatic or manual valves which will shut off the flow of water to a machine when it is not in use. This approach could take the form of hand- or foot-actuated valves to shut off the rinse water when a plating line is not in operation. On an automatic plating machine, the valve might be operated by a solenoid actuated by the conveyor of the machine. Figure 1 shows how a solenoid valve can be connected into the piping of a welder so that cooling water will flow only when the apparatus has been turned on for operation. Another method is to install water controllers which utilize various sizes of orifices to limit the amount of water that can be obtained through a line for a particular job. Among other conservation practices are:

1. The installation of more piping to get additional use of cooling water as it passes through the plant.

2. The use of the same cooling water in metal-finishing rinse tanks, or other containers, so that a given volume of water will do two or three times as much work.

3. The introduction of a spray to replace running-water rinses for cleaning operations.

Considerable cost reductions can be achieved by water conservation. One plant, which uses only 160,000 gpd, had a saving of $6,000 per year; another department, with a water requirement of 596,000 gpd, realized savings of $12,000 per year.

Recirculation

In plants where large quantities of cooling water are used, efforts to save water beyond mere conservation are probably justified, although such an approach is more costly. The fundamental concept in recirculation is to retain all clean or cooling water through the installation of holding, cooling, and pumping facilities so that such water can be used over and over. The amount of water consumed is then restricted merely to the makeup to the recirculation system to replace evaporation and windage losses, plus the bleeddown necessary to keep the mineral content of the recirculating water

TABLE 3

Consumption and Cost of Water from Private Sources

Consumption *gpd*	Number Of Plants	Total Yearly Consumption *gal*	Costs	
			Per Year $	Per 1,000 Gal ¢
Less than 50,000	1	7,260,000	323	4.4
50,000—100,000	2	39,608,000	3,086	7.8
100,000—250,000	4	171,028,000	5,163	3.0
250,000—500,000	1	109,000,000	4,500	4.1
500,000—1,000,000	3	473,840,000	31,890	6.7
Over 1,000,000	5	14,778,561,000	489,476	3.3
Total	16	15,579,297,000	534,438	

from reaching too high a concentration. This replacement is obviously much less in volume than that required in one-pass cooling operations. Experience of the General Electric Co. indicates water can be recirculated at a cost of 3.6 cents per 1,000 gal, including equipment depreciation. Every particular plant must be studied to determine whether a central recirculation system or a number of smaller ones is the most economical answer. When water is recirculated, cooling is generally accomplished through the use of one of these installations:

1. *Cooling pond.* A cooling pond collects all the warm, used water. Pumps spray a portion of the pond water into the air and evaporation reduces pond temperature to the desired level. Where increase of temperature is not of great significance, a reservoir or pond without sprays will permit satisfactory recirculation. In many plants the secondary ground water reservoir for fire protection can be made some-

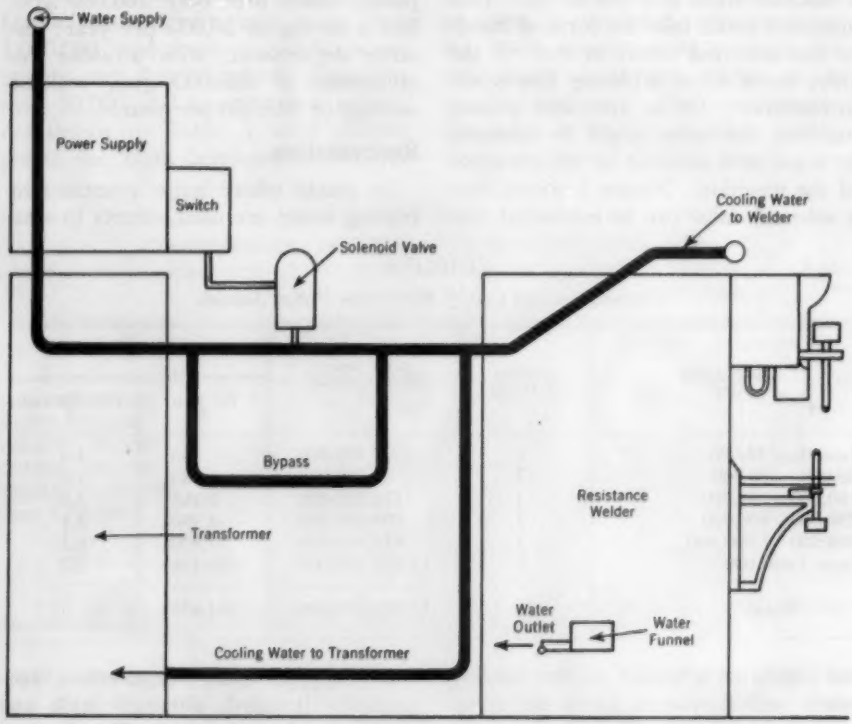

Fig. 1. Automatic Control of Cooling Water

The solenoid valve permits cooling water to flow only when the welder is in use. The bypass is normally closed.

what larger than necessary and used as a cooling pond as well.

2. *Cooling towers.* In cooling towers the water is pumped from a reservoir beneath a wooden tower to its top and then permitted to fall back into the storage tank against a current of air usually forced up through the structure. Often the major cooling-water reservoir is separated from the tower. The former is placed in the basement of, or adjacent to, a building, while the latter is located on the building's roof. A single tower that cools water from a number of items of equipment is frequently used in a centralized manner (see Fig. 2).

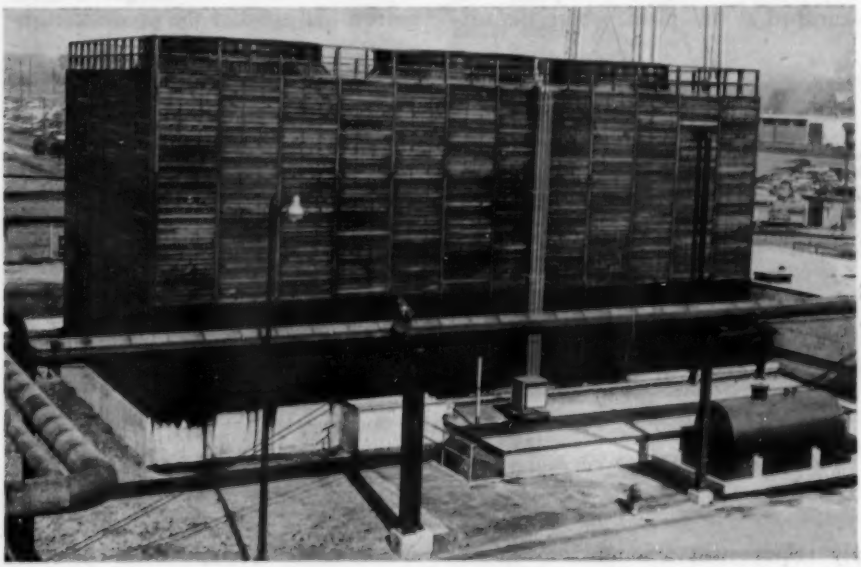

Fig. 2. Cooling Tower

This wooden structure cools water for recirculation to several items of equipment.

3. *Evaporative condensers.* Evaporative condensers, widely used in recent years to replace water-cooled condensers have particular application to cooling the condensing coils of refrigeration systems. Because evaporative condensers are far more efficient than water-cooled condensers in conserving water, substitution of the former devices should reduce consumption by approximately 98 per cent.

When an evaporative condenser is used, the heat taken from the refrigeration installation, air-conditioning unit, or cold box in the factory by the circulating refrigerant is passed through condensing coils over which recirculating water is sprayed. An air-cooling section in the condenser transfers the heat to the air by evaporation. Evaporative condensers may be placed either indoors or outdoors (Fig. 3).

Electronics Park Plant

In the Electronics Park Plant at Syracuse, N.Y., as in all recently built General Electric Co. plants, economical water conservation devices were installed at the time of construction (*6*). The 68 evaporative condensers that were included as a part of the original plant save 415 mil gal per year. In 1950, a program aimed at further reduction of water consumption was launched at this plant, where the supply requirement amounted to 1,580,000 gpd. The steps in this program were: [1] the provision of refrigeration equipment for water that cooled machines; [2] the installation of pumps and piping to recover water from a spring in the basement of a building; [3] the installation of shut-off valves on the welders; [4] the regulation of the flushing valves in the urinals so that cleanliness is maintained without waste; [5] the installation of a cooling tower; and [6] the provision of water meters. These steps and the condensers originally installed have reduced water consumption by 648 mil gal per year, representing an annual savings of more than $100,000. The equipment necessary to make possible this conservation had a cost of about $150,000 over equipment which would otherwise have been necessary (*5*).

Production has risen at Electronics Park by about 25 per cent since 1951, a year in which 490 mil gal was required. In spite of the production increase, in 1953, only 398 mil gal was used, a saving that conclusively demonstrates the benefits of a water management program.

Fig. 3. Evaporative Condensers

These three evaporative condensers are installed outdoors on the roof of a plant building.

Conclusions

1. The water resources of the nation must be preserved and protected because they are of vital importance to the future development of industrial, municipal, and individual enterprise.

2. Industry should adopt a management program which includes the selection of the best source of supply, control of water throughout all the

manufacturing processes, and delivery of an effluent that does not destroy the water resources of the area for others.

3. Because vast quantities of water are required in the operation of a large industry, the cost of this item is of great importance.

4. Major industrial water consumers should adopt a water management program:

a To make a contribution toward the proper employment of a resource upon which the future welfare of the nation is vitally dependent

b To take the first and most economical step toward simplifying the industrial wastes problem

c To reap the cost reduction benefits which accrue from sound water usage.

5. The fundamental steps which a plant should incorporate into its water management program are:

a The evaluation of current consumption and cost conditions.

b The practice of conservation throughout the plant

c The employment of recirculation and reuse wherever justified.

6. Water management pays cost reduction dividends, according to experience of the General Electric Co. For example, a large plant with a complete program is saving over $100,000 per year, and two smaller departments are saving $6,000 and $12,000 per year through conservation alone.

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Corrections to 'Standard Methods'

Attention is called to the following errors that appeared in the initial printing of the tenth edition of *Standard Methods for the Examination of Water, Sewage, and Industrial Wastes.* These errors have been corrected in the second printing:

1. *Page 136, Par. 3.3, 2nd line.* Reads: 3.1 g. *Should read:* 0.31 g.

2. *Page 252, Par. 2.5.* The last factor on the right side of the equation is illegible. *It should read:* $12I_2$.

3. *Page 253, Par. 2.7, 2nd line.* Reads: 24.82 g. *Should read:* 248.2 g.

4. *Page 255, Par. 4.4, Equations 1 and 2.* The numerator on the right side of the equations reads: $P - u \times$ . . . . *Should read:* $(P - u) \times$. . . .

5. *Page 264, Par. 3.6, last line.* Reads: reliable. *Should read:* unreliable.

6. *Page 308, Sec. 3. Delete:* 3.10—Ferrous sulfate. *Renumber subsequent paragraphs to read:* 3.10, 3.11, 3.12.

7. *Page 378, Par. 1.3.* The next-to-last line of the next-to-last paragraph reads: broth to a tube of standard lactose. . . . *Should read:* broth to a plate, thence to lactose. . . .

The following errors were noted too late for correction in the second printing. They will be corrected in the third printing:

1. *Page 47, Par. 2.3.1a, 2nd line.* Reads: 0.025. *Should read:* 0.25.

2. *Page 126, Par. 3.4, last line. Add a new sentence:* Store in a cool, dark place.

3. *Page 135, Sec. 4.* The numerator on the right side of the equation reads: Mg_2PO_7. *Should read:* $Mg_2P_2O_7$.

4. *Page 153, Par. 1.1, next-to-last line.* Reads: Beer's law up to 0.6 mg/l with a. . . . *Should read:* Beer's law up to 0.18 mg/l as nitrogen, or 0.6 mg/l nitrite, with a. . . .

5. *Page 170, Par. 4.2.* After the 13th line ("After . . . min"), *insert the following:* using the same specific interval for all determinations, . . .

6. *Page 197, Sec. 4 (top of page).* The numerator on the right side of the equation reads: 41.15. *Should read:* 411.5.

7. *Page 339, Par. 2.1, 3rd line.* Reads: 1 liter. *Should read:* 100 ml.

8. *Page 17. Delete* the first full paragraph in the right-hand column. *Substitute the following:* As a general rule, results shall be expressed in terms of the substance actually determined. Exceptions to this, such as reporting boron as the element, B, rather than as borate, will be noted in the sections dealing with specific determinations.

Establishing Rates and Service Charges at Manhattan, Kansas

W. B. Avery

A paper presented on Apr. 14, 1955, at the Nebraska Section Meeting, Lincoln, Neb., by W. B. Avery, City Mgr., Manhattan, Kan.

THE most serious problem of the past few years in Manhattan, Kan., has been concerned with water. For example, in 1951 there was a serious flood, which covered half of the city. Soon after this disaster, it became apparent that a water shortage was imminent, despite the fact that the underground supply is practically unlimited. This contradiction arose, in part, because the water contains 7–10 ppm iron and 450 ppm hardness, which must be reduced by expensive treatment. Any long-range plan for increasing supply has to take into consideration the necessary additional treatment and pumping facilities. A survey in 1952 showed that the city had completely outgrown its distribution system. The entire development necessary would entail a minimum expenditure of $1,165,300, allocated as follows: [1] distribution system, $745,300; [2] treatment facilities, $375,000; and [3] new wells, $45,000.

Air-Conditioning Problem

Population growth has contributed to the greater use of water, but the largest factor is increased consumption per capita. A 1946 survey showed that consumption was 90 gpcd. In peak periods today, this amount has risen to 220–250 gpcd. Automatic washers, garbage grinders, showers, dishwashers and air conditioners are a factor in this development. Unless conservation of water used in air conditioning can be encouraged, utilities will have grave problems to handle. A recent study (*1*) made by a large manufacturer of water works equipment reveals that if homes only were completely air conditioned (without conserving units), peak production facilities would have to be increased 10–12 times their current capacities.

In 1953, 300 tons of air conditioning was connected to the municipal system. Thus, 18.9 per cent of the daily supply was used by only 1.14 per cent of the total users. Two large units installed in 1954 have doubled the air-conditioning capacity and would have increased the percentage of use by such devices from 18.9 per cent to 37.8 per cent if conservation techniques had not been employed. A proposed service charge induced the installation of such apparatus or the development of private wells. Thus, there was a reduction of 125 tons of air conditioning dependent on the public supply. In addition, the two new air-conditioning units were provided with cooling towers.

Service Charge

The service charge had a base rate of $2.50 per ton of air-conditioning

capacity per month for June–September (assessed only on units without conservation). This schedule was adopted in September 1953 to become effective in May 1954 in order to provide consumers with sufficient time to install conservation devices if they decided to do so. The surcharge is intended to encourage the use of conservation units, not only to prevent overtaxing water production facilities, but also to forestall overburdening sanitary sewers with used air-conditioning water. The extra charge will be paid by consumers who force a plant expansion to cover their peak demands. The $2.50 per ton service charge is not sufficient to pay much more than the interest on the added investment, which will be approximately $500,000.

Conserving units will be paid for in approximately 3 years by the savings effected in the use of water and on the surcharge. The assessment is only an interim measure, which must be followed by prohibiting new air conditioning except where conserving units are provided. The reason for this necessity lies in the fact that the discharged water will overload sewer and sewage treatment systems within the next 5 years in most cities, a situation which has already occurred in several localities. Moreover, the increased demand on the water system may affect fire ratings to the extent that insurance rates would have to be raised.

New Accounting System

Much advance planning had to be done to provide the groundwork for the establishment of a new rate structure. Before Jan. 1, 1952, the water department accounting system had consisted of cash accounts and little else. Because cost records for the water works were not maintained, charges for depreciation could not be made. As a result of this condition, rate changes were out of the question until a better method of accounting could be put into practice.

In the fall of 1951, a complete property appraisal was made for insurance valuation. Depreciation rates were established and a complete double-entry accounting system which would provide a monthly statement of operating conditions on a cumulative basis was developed. These records are maintained in the finance section of the city manager's office. The new system showed from the first that the rate structure was not adequate, because normal depreciation could not be applied without showing a deficit. For example, the largest user paid, on an average, $1.40 per 1,000 cu ft, whereas the cost of operation was $1.43 per 1,000 cu ft.

Following the change in the centralized accounting procedures, steps were taken to improve the billing operations. A machine was purchased that prepared the billing cards and ledger cards simultaneously. It was designed with sufficient latitude to provide space for new charges that may be made in the future.

Billing was changed from quarterly to monthly. The reasons for this step are:

1. The savings from detecting stuck meters easily pay for the extra meter reader.
2. The improvements in procedures save sufficient time to obviate the addition of new clerical personnel for the more frequent billing operation.
3. The income coincides with the settlement dates of accounts and payrolls which have to be met by the utility.

4. The new procedure is the same as the proved practices of privately owned utilities.

The accounting improvements have made it possible to budget utility operations simultaneously with other municipal programs. Capital improvements, projected from reports developed by consulting engineers, are planned on a long-term basis within the utility's financing abilities.

Cost Allocation Method

The city is obligated to supply free water to various institutions. Such distribution amounts to 29,385,000 cu ft per year. Metered sales account for 81,365,000 cu ft per year. The accounts of the water department are kept according to standards established by the National Committee on Governmental Accounting (*2*). In allocating costs, the operating-expense section is classified under pumping, purification, transmission and distribution, and administrative and general. The income and expense statement, the operating and nonoperating classifications, and the operating and nonoperating income classifications, are incorporated into the accounting and reporting system.

TABLE 1

New Rate Schedule

Quantity* *cu ft*		Cost *$/1,000 cu ft*
First	400	1.10†
Next	4,600	2.75
Next	15,000	2.25
Next	25,000	2.00
Next	55,000	1.75
More than	100,000	1.50

* For air-conditioning systems using city water to cool condensers, an additional charge is made of $2.50 per month per ton of rated capacity during June–September.

† Minimum charge $1.10 per month.

Total use for the calendar year of 1953, was 110,750,000 cu ft, at a cost of $1.426 per 1,000 cu ft. The amount of 81,365,000 cu ft was sold at a cost of $1.941 per 1,000 cu ft. At present, only water that is sold is metered at the consumer's premises. Consideration is being given to metering all locations, however, in order to collect information on use.

New Rate Schedule

The old rate schedule contained ten steps, too many for practical use. The new schedule, therefore, has only six steps (see Table 1). The 100,000 cu ft bracket carries a considerably higher rate than the corresponding divisions of the discarded schedule. Although this rise is fairly steep, the margin between the sale price and the cost of the water is still not very wide.

The new rates are so devised that the residential, not the industrial, user carries the cost of the free water furnished to churches and schools. The minimum charge of $2.50 per quarter under the old schedule provided for 1,000 cu ft of water, whereas the new minimum of $1.10 is for 400 cu ft. This cost is the lowest at which individual tap service can be furnished. The rate revision reduced the connected tonnage of air-conditioning units projected for 1954 by 79 per cent, providing time to develop plans for system developments and making it possible to do without restrictions on general use. To date, capital improvements amounting to $75,000 have been made from current operating funds. It would be desirable to continue this procedure, but the increased demand for water may require a more rapid expenditure. The revised rate structure will provide ample funds for debt service.

Monthly operating and budget statements prepared for the utility and its various general operating funds are made on a cumulative basis and provide a record of gross and unit operating cost, as well as gross and net income. The adequacy of rates can be determined from these accounts on a monthly basis, if desired. The utility should ideally have only enough income to carry out needed expansion after the operating costs are met. If the rates yield too high a return, adjustments are made immediately by municipal ordinance.

Fringe-Area Policy

The gradual tendency to establish residence in fringe areas has caught many cities with unwise commitments for future development. It is well known that the population growth on the perimeters of cities constitutes a serious threat to their welfare. In most cases, the desire to escape the obligation of municipal taxes while continuing to receive urban benefits has motivated this exodus. Many towns provide water service and fire protection at the same cost to both outlying and metropolitan districts. The Manhattan City Commission has adopted the policy of not extending new water lines beyond the corporate limits. The rates to users outside the city are double that of those inside. Numerous requests for annexations of the suburban sections have been made since this policy went into effect.

Municipalities that have had an unlimited supply of water have been very fortunate. In most cities, restrictions on some applications have been necessary to insure water for high-priority uses. Such expedients have provided valuable time to expand facilities before shortages became very severe. An extremely important tool of management in the planning of these improvements is a sound accounting and reporting procedure.

References

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Water Resources Policy for the State of Washington

W. A. Galbraith

A paper presented on May 19, 1955, at the Pacific Northwest Section Meeting, Yakima, Wash., by W. A. Galbraith, Director, State Dept. of Conservation & Development, Olympia, Wash.

WHERE water is abundant, as in some parts of the Pacific Northwest, man has an unfortunate tendency to misuse it. Washington has a great variety of terrain—ocean beaches, towering mountains, and flat, level areas. In this state are located serene mountain lakes, streams that sometimes become torrents, and one of the greatest rivers in the world. In some parts snowfall is unusual, in others, snow is ever present. One section of eastern Washington has one of the lowest annual rainfalls in the nation, while the rain forest area of the Olympic Peninsula has the nation's heaviest annual precipitation.

Washington as a whole has a great deal of water, but it is badly distributed. The consumptive use of water is constantly becoming greater because of increasing population and new applications. This comparatively young area of the United States has an opportunity to profit by errors, primarily of inaction, made in older states. It is easier, less expensive, and wiser to keep the water in good condition as it is developed than to clean it up after pollution has taken place. It is also more prudent to make the best use of water as the state grows, rather than to make corrections later.

Need for Water Policy

In 1954 Governor Langlie of Washington spoke to the chiefs of state departments having to do with water resources. He said that the time had come when the state must develop and implement an overall water policy in order to make the best use of that basic resource. The governor's statement came as no surprise to the directors of the departments of public health, agriculture, fisheries, game, and conservation and development. The heads of these organizations had already been meeting regularly as the Pollution Control Commission.

For some time it had been obvious that a genuine overall water policy was badly needed. When the governor set up the Water Resource Policy Committee, he started official action in this direction. The committee soon realized that it was confronted with a very difficult task. The five departments involved, using their best qualified staff over many months, finally reached agreement. In April 1955 the Committee made the following statements as principles on which to base an overall policy:

A bountiful water resource has and will continue to play an important part

in the economic and industrial development of the state of Washington. While the nature of this resource is essentially continuous and renewable, it is becoming increasingly apparent that maximum sustained water utilization requires that wise methods of water use be developed. . . .

. . . Many interests are involved, each being important, but this importance in each case is influenced by association with other interests. Only through a recognition of all interests in their proportion by all persons involved will the resources be fully and wisely used. . . . In recognition of this need, Governor Langlie has appointed a Water Resource Committee with instructions to draft a water resource policy and develop a water plan for the state. In its final draft, it is expected that this policy will be used as a guide to departments, agencies and all others involved in water use and management activities within the state.

The committee, in its considerations to date, has made the following determinations regarding the development of the water plan:

1. That the overall plan will consist of a composite of plans, each involving a drainage or geographical area in which the water problems are similar

2. That an inventory be made of the water resources in each of these areas, using such data as is available and collecting any additional information necessary . . .

3. That present and potential water uses be established and estimates made of water requirements under fully developed conditions

4. That priorities of use be established which will make the best use of the resource available

5. That a plan be developed, taking into account the interests of adjacent areas and the entire state and its relation to other states and Canada.

Type of Water Policy

The author believes that the Water Resource Policy Committee assumed a grave responsibility in making these statements. In any given watershed, there appear to be these alternatives in the development of the water resources:

1. To let the use of the water grow naturally as the area develops

2. To follow the present method employed in Washington of allowing water rights to anyone unless there are valid protests

3. To develop the best water use program for the watershed, taking into consideration its relationship to the state as a whole.

Obviously, the first method was outmoded long before the present period in the state's economic and social development. In the author's opinion, the best procedure is now the second. Because the state is continuing to grow, however, the third alternative will very soon become necessary. Under the present system, there is no final authority on what is the best and wisest use of any given water. Every particular interest naturally feels that it should be given main consideration in the use of water resources. It is the purpose of a water policy to resolve possible conflicts before they arise and to do the most good for the greatest number of persons over the longest period of time.

A proposed policy was prepared and presented for a public hearing in June 1955. If this statement, which gives due consideration to all uses and which is flexible enough to meet most demands, becomes official, however, considerable work will be required to make it effective.

AWWA Safety Manual

Part 3—Safe Working Practices

After several years of study, AWWA Committee A2.E—Safety Practices has prepared a manual of safety practices for water utilities. The document is being published in several installments (July 1955 issue, p. 637; August, p. 791; September, p. 923). When serialization is completed, the manual will be made available as a separate volume for easy reference.

Section 21—Gas and Arc-Welding

Use of Compressed Oxygen

1. Never permit oil and grease to come in contact with oxygen cylinders, valves, regulators, gages, and fittings, because oxygen unites explosively with such substances.

2. Do not handle oxygen cylinders or apparatus with oily hands or gloves.

3. Never use oxygen from a cylinder without reducing the pressure through a suitable regulator intended for that purpose.

4. Keep the protective cap in place until the cylinder is ready to be connected.

5. After removing the valve cap, twist the valve handle for an instant to clear the opening of particles of dust or dirt.

6. If a valve is difficult to twist, point the valve opening in a safe direction and apply greater force; avoid the use of a wrench on valves equipped with hand wheels.

7. Make sure that the adjusting screw of the regulator is released after attaching it and before the cylinder valve is opened.

8. Never permit oxygen to enter the regulator suddenly; open the cylinder valve slowly.

9. Before the regulator is removed from a cylinder, close the cylinder valve and release all gas from the regulator.

10. Do not permit sparks or flame from the welding or cutting torch to come in contact with the cylinder.

11. Never interchange oxygen regulators, hoses, or other appliances with similar equipment intended for use with other gases.

12. Be certain that where oxygen cylinders are connected to manifolds or headers, the latter are properly designed and equipped with one or more pressure regulators. (Oxygen manufacturers will be glad to furnish specifications for construction and installation of proper oxygen manifolds and pipelines.)

13. Open the cylinder valve fully when the cylinder is in use.

14. Never attempt to mix gases in an oxygen cylinder.

15. Never use oxygen as a substitute for compressed air. (It is dangerous to use oxygen for pneumatic tools, to start diesel engines, for imposing pressure in oil reservoirs, for paint spraying, for blowing out pipelines, or for other such applications.)

Storage of Compressed Oxygen

1. Do not store cylinders near flammable material, especially oil, grease,

or any substance likely to cause or accelerate fire. (Oxygen is not flammable, but it supports combustion.)

2. Do not store reserve stocks of cylinders containing oxygen with reserve stocks of cylinders containing combustible gases; separate the two lots.

Use of Acetylene

1. Acetylene cylinders should be used and stored in an upright position to avoid the possibility of spilling acetone.

2. Keep sparks and flame away from acetylene cylinders; avoid hanging lit or unlit blowpipes from the regulators attached to the cylinders.

3. Never pass acetylene from cylinders through blowpipes or torches without having a suitable regulator attached to the cylinders.

4. After removing the valve cap, open the valve for an instant to clear away particles of dust or dirt.

5. Release the adjusting screw of the regulator after it is attached and before the cylinder valve is opened.

6. Close the cylinder valve and release all gas from regulator before removing it from a cylinder.

7. Never interchange acetylene regulators, hoses, or other appliances with similar equipment intended for use with other gases.

8. Never transfer acetylene from one cylinder to another and do not mix acetylene with another gas in the cylinder.

9. Never use manifolds for acetylene cylinders unless the former were properly constructed.

10. Always keep the wrench for opening the valve on the valve spindle when the cylinder is in use.

11. Close the valves and put the caps in place to prevent leaks when returning empty cylinders.

12. Never attempt to refill an acetylene cylinder.

13. Be aware that the pressure in an acetylene cylinder does not accurately indicate the amount of gas contained. (The quantity is determined by the weight of the cylinder and its contents.)

14. Never test for acetylene leaks with an open flame; use soapy water for this purpose.

15. Never bring acetylene into contact with unalloyed copper, except in a blowpipe or torch.

Storage of Acetylene

1. Do not store reserve stocks of acetylene cylinders with reserve stocks of oxygen cylinders; separate the two gases.

Equipment and Welding Circuits

1. Keep welding leads and primary power leads clear of ladders, passageways, or doors; do not place leads and cables used to conduct power to portable welding units where machines or trucks may run over them.

2. Repair or replace defective cable immediately; use locking joint–insulated cable connectors whose capacity equals or exceeds that of the cable; disconnect the power before splicing any cable.

3. Do not allow the power supply cable used for portable welding units to become tangled with the welding cables or to be near enough to the welding operation to sustain damage to insulation from sparks or hot metal.

4. Do not start welding unless all electrical connections, the power, supply, and welding leads, the holder, and the ground clamp are secure and the welding machine frame is well grounded. Securely attach the work clamp before beginning to weld.

5. Disconnect the welding machine from its power supply when the former is to be left unattended.

Personal Protection

1. Do not strike an arc unless a face shield or helmet protects the face and eyes of everyone nearby.

2. Wear a skull cap under the welding helmet.

3. Be certain that the face shield or helmet is light tight and that it adequately protects the eyes, head, face, and neck.

4. Always wear eye protection when chipping slag.

5. Wear good leather gloves of the gauntlet-type which are loose enough to be easily removed.

6. Wear high-top shoes, preferably of the unlaced-boot-type, to prevent weld spatter burns on the feet and ankles.

7. Weld only in a dry place and with dry equipment. (If conditions are otherwise, supervising personnel with proper authority should approve the operations.)

8. Keep shirt sleeves buttoned and pockets closed to avoid catching dangerous weld spatter.

9. Inspect personal protective equipment before beginning to weld.

10. Treat all electric devices, such as welding machines, portable electric tools, lights and blowers, with the utmost respect; do not remove light bulbs without turning off the current. (Exposure to electricity does not develop immunity.) Keep dry, and use special precautions to insulate the body when clothing is wet from perspiration or other moisture.

11. Weld with a fully insulated electrode holder.

12. Remove electrode stubs from the holder only when the body is not in contact with the work.

13. Do not weld in confined quarters without first installing positive ventilation to assure a good supply of fresh air.

14. When welding or cutting brass, bronze, galvanized steel, cadmium-coated steel, or metals coated with lead or zinc-bearing paint either indoors or outdoors, make sure that appreciable quantities of the fumes are not breathed. (An exhaust system to remove toxic gases at their source is recommended; if this procedure is not possible, adequate respiratory protection must be supplied.)

15. Place holders that are not in use where they will not come in contact with workers or other metal objects.

16. Do not attempt to weld any kind of tanks, open or closed, until they are steam cleaned to eliminate the danger from flammable gases.

17. Either remove all flammable material from the area in which welding or cutting is to be done, or cover and shield vulnerable objects from sparks; have a fire extinguisher nearby.

Section 22—Elevated Tanks

Climbing

Only trained and experienced workers should be permitted to work on standpipes and elevated tanks. Such occupation is hazardous and not suited to the water works employee untrained in this type of activity. It is seldom advisable to employ nonprofessionals for the necessary periodic inspections of tanks. Observe the following precautions:

1. Use a safety belt wherever possible.

2. Keep shoes in good repair at all times; before climbing, inspect shoes

and remove oil, grease, mud, or other slippery material.

3. Face the ladder when ascending or descending; always use both hands; do not permit more than one person on a ladder at the same time.

4. Keep ladder rungs free of oil, grease, mud, or other slippery material.

5. When using a ladder for the first time:

a. Carefully inspect for defective rungs, loose weldings or rivets, and other dangerous conditions.

b. Test each rung before entrusting full weight on it.

c. Note carefully the width and spacing of the rungs.

d. Be extra careful if rungs are placed in a stagger pattern.

6. Step on every rung; use a ladder with safety feet.

7. Protect ladders set up in alleyways, walkways, and roadways.

8. Do not place ladders on slanting, oily, or slippery surfaces; if this procedure must be followed, secure the ladder thoroughly or have it held by another employee.

9. Do not step on the top rungs unless the ladder is adequately secured and hand grips above the ladder have been provided.

10. Do not remain on a tank during an electrical storm.

Repairs

1. Follow these safety measures:

a. Do not wear loose, bulky, or torn clothing.

b. Wear hard safety hats when underneath overhead work.

c. Use a safety belt above ground if both hands are needed for the work.

d. Wear an approved respirator or fresh-air mask when spray painting or when exposed to dangerous vapors, fumes, and dust.

e. Wear safety goggles, masks, or face shields when wire brushing, chipping, dusting, sand blasting, welding, burning paint, or washing down with disinfecting solutions.

2. Properly use and maintain tools and equipment for work in this fashion:

a. Keep tools clean and in good repair.

b. Do not use matches or other open flames in tank interiors; secure illumination from vapor-proof flashlights or electric lights.

c. Ground all electrical equipment; use three-pronged plugs having a third long ground lug, or use a ground wire if three-conductor cable is not available.

d. Use only extension cord that is approved by the Underwriters Laboratories and labeled to show that all the requirements of the National Electric Code are met; inspect such cords regularly before using.

e. Provide only rubber-sheathed cords for equipment in tanks and other grounded structures.

f. Use low-voltage equipment, not over 32 v, in damp locations and in tanks that are wet or that will cause excessive perspiration.

g. Use bronze tools if there is any danger from flammable or explosive gases.

3. Before entering a tank:

a. Check for dangerous and explosive gases and vapors or absence of oxygen by approved equipment and methods.*

b. Inspect the ventilation; provide ventilating equipment if natural ventilation is not adequate.

c. Install sufficient lighting for dark interiors.

d. Place portable generators, compressors, and other equipment where

* Consult "Mine Gases and Methods for Their Detection," Circular No. 33. US Bureau of Mines, Washington, D.C. (1948).

their engine exhaust gases will not enter the tank.

e. Before starting work in the tank interior, if there is no permanent grating, cover the riser opening with timbers, grating, or other protection.

4. Keep a firm grip with one hand if it is necessary to work for a brief period of time from a ladder; do not reach farther than an arm's length from the ladder; use a safety belt if work at one location will take a lot of time.

5. Do not work from a ladder in a high wind.

6. Do not inspect or work alone on or inside a tank. (A man entering a tank from the roof should always have

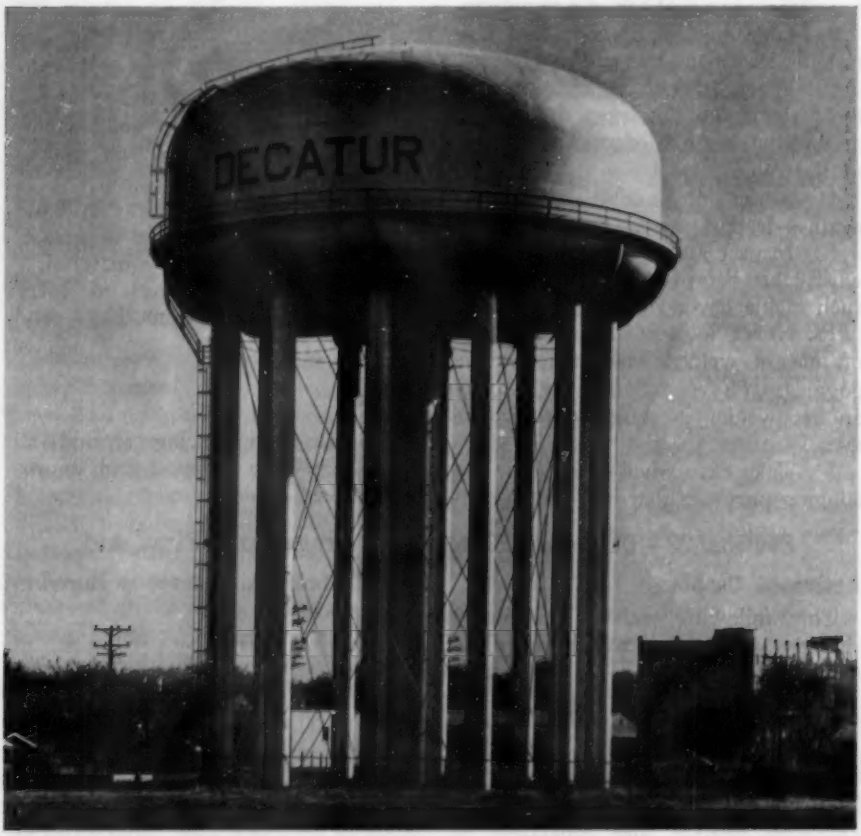

Fig. 24. Elevated Tank

Safety cages are on all ladders; a handrail is placed on the roof section of the ladder; a handrail is around the balcony; radial rods are located directly under the tank bottom so that painters' scaffolds may be safely hung; obstruction lighting is installed halfway up the standards and on the balcony and apex of the roof; a fence 6 ft in height protects the site from trespassing.

a safety line securely fastened to him; a helper on the outside should hold the line and be available at all times in case of an emergency.)

7. Securely fasten all temporary planks and scaffolding.

8. Carry tools in tool box, bag, or tool belt; never carry tools in pockets or a pants belt, particularly sharp-edged or pointed tools; keep the number of tools in a tool belt at a minimum.

9. Haul tools, equipment, and materials with a hand line and tool bucket.

10. When descending, bring the tools along; do not leave them lying around on elevated ledges, angle irons, or the roof.

11. Adopt all possible precautions against dropping tools.

12. Inspect all rope and tackle and wire cable before using; do not load such tackle beyond rated capacity.

13. Never look at the direct light of an arc welder without protective goggles. (Even reflected light from an arc welder is sufficient to injure eyes.)

14. Take care when using rope for slinging purposes that it is not in contact with sharp edges, which may result in its being frayed or cut; apply blocking and padding where needed.

Hand Holds and Railings

1. Provide cages for fixed ladders over 25 ft in height (see Fig. 24).

2. Provide hand holds or grips above the tops of all ladders.

3. Provide railings for balconies and stairways.

4. When working around tanks for the first time, carefully check all railings, hand holds and gratings; do not assume that they are in good condition, and do not use or lean against them until tested.

5. Ascertain before use that hand holds and railings are free of grease, oil, ice, or other slippery material.

6. Do not use railings to carry weights and loads from block and tackle.

Fencing

Provide high fencing around all tanks that have exposed and unprotected fixed ladders.

Section 23—Chemical Handling, Storage, and First Aid

Activated Carbon

The following safety procedures should be adopted to minimize or eliminate hazards:

Handling and Storage

1. Dust masks should be worn when bags of carbon or bulk material are unloaded or otherwise handled (Fig. 25); excessive dusting and inhalation of carbon dust should be avoided.

2. Carbon should be stored in a clean, dry place, in single or double rows, and with access aisles around every stack for frequent fire inspections; the removal of burning carbon will thus be facilitated.

3. Carbon should never be stored in large stacks.

4. The storage area should be of fireproof construction, with self-closing fire doors separating the carbon room from other sections.

5. Storage bins for dry bulk carbon should be of fireproof construction, equipped for fire control by the installation of carbon dioxide equipment, or should be so arranged that they can be flooded with a fine spray of water.

6. Carbon storage areas should be protected from contact with flammable materials; carbon dust mixed with oily rags or chlorine compounds can ignite in spontaneous combustion.

7. Smoking should be prohibited at all times during the handling and unloading of carbon and in the storage area.

8. Carbon should not be stored where a spark from overhead electrical equipment could start a fire; if a fire occurs, the carbon monoxide hazard should be taken into account (see paragraphs on Carbon Dioxide—Ventilation below).

9. Electrical equipment should be protected from carbon dust and cleaned frequently or, better, explosion-proof electrical wiring and equipment should be used. (The heat from a motor may ignite the accumulated carbon dust; this material, especially when damp, is a good conductor of electricity and may short-circuit the mechanism.)

Controlling Fires

1. Contrary to the behavior of some dusts, mixtures of activated carbon dusts floating in air are not considered to be explosive; tests conducted by carbon manufacturers have failed to indicate any explosive tendency.

2. Activated carbon, as ordinary charcoal, burns without producing smoke or flame and glows with the release of intense heat. Such fires are difficult to detect and when found are equally hard to handle. Those in large storage bins or stacks may exist for some time before being discovered. The smell of charred paper from the bags or the scorching of the paint on the side of the bin are indications that a carbon fire is in progress.

3. Burning carbon should never be doused with a large stream of water as the fire will be spread when burning particles of carbon fly in all directions, as a result of the intense heat and the formation of steam. Hoses equipped with controllable fog nozzles are very useful. Carbon dioxide extinguishers will help check an open carbon fire but will not put it out; carbon dioxide is effective in enclosed storage bins, but acts rather slowly. To avoid the carbon dioxide and carbon monoxide hazards of a carbon fire, personnel working in the area should be instructed to wear gas masks provided with oxygen.

4. It should be remembered that the pores of activated carbon have sufficient absorbed oxygen to support combustion in the absence of outside air; carbon will start to burn without atmospheric oxygen if a temperature of 350–450°F is reached, depending on the type of material. The best way to combat a large carbon fire is to soak the burning substances thoroughly with cold water from spray nozzles to reduce the temperature below the ignition point.

5. Small fires (consisting of 1–3 bags of carbon) should be dealt with by removing the burning material to a safe place with long-handled shovels and a steel wheelbarrow. If the carbon is properly stacked, such fires can be controlled quickly and with a minimum of manipulation.

6. Blocks of dry ice have been used to control carbon fires in storage bins and confined areas, but without much effectiveness. (In a fire on a hopper car of bulk carbon at Chicago in 1951, 4,500 lb CO_2 and 360 lb dry ice were employed without appreciable effect, extinguishment being achieved with a water spray.)

Protective Equipment

1. An approved type of dust mask should be provided for all personnel handling or working with activated carbon; if dust is excessive, chemical goggles should also be worn. Loose-

fitting, dust-proof clothing, with the collar closed and the ankles tied at the shoe tops, will offer good protection from dust (Fig. 25).

2. Adequate shower facilities should be provided for all personnel handling carbon; liquid soaps that are rather mild and compounded especially for removing carbon blacks should be available; use of harsh soaps and detergents should be avoided.

Fig. 25. Protective Wear for Carbon Handling

The workman is wearing a cap, dust mask, goggles, and gloves. His clothing is tied at the wrists and ankles.

3. Dust collection equipment should be provided at points where carbon is being unloaded into bins or hoppers. Similar gear is advisable in transferring bulk carbon from hopper cars to bins or tanks, not only to prevent excessive dust but also to release air pockets.

Alum and Ferrous Sulfate

The following safety procedures should be adopted to minimize or eliminate hazards:

Handling and Storage

1. Workmen should wear dust masks and chemical goggles (Fig. 26) when they are handling or are exposed to aluminum sulfate or ferrous sulfate dust. Both chemicals are irritating to the skin and mucous tissue because of their acid and anhydrous nature, and the dust can cause serious eye injury.

2. Loose, denim quality, dustproof, long-sleeve clothing should be worn, with a bandana and a cap; trousers should be tied at the ankles, and protective cream should be placed on exposed skin surfaces (Fig. 26).

3. The material should be stored in a clean, dry place because moisture has a tendency to cause caking; when it is necessary to clean storage bins, hoppers, and other containers, the same precautions should be observed as in handling the chemicals.

4. Electrical equipment subject to exposure to ferrous sulfate dust should be of dustproof construction. Because this chemical readily absorbs moisture —particularly on humid days—and is a conductor of electricity when damp, it may cause short circuits and corrosion which can ruin essential equipment.

5. Compressed air should not be used to clean dry-feed machines and appurtenances; an industrial water chamber vacuum cleaner is much safer.

6. When handling the chemicals, an effective dust mask should be used,

and an adequate supply of reserve filter pads should be kept on hand. (The mask is not operating properly if the materials can be tasted while it is being worn).

7. It should be remembered that mixtures of dry alum and quicklime can generate heat and explode if confined; the same conveyor or dust-collecting equipment should not be employed for both materials unless the apparatus is properly cleaned after each use.

8. Mechanical dust-collecting apparatus should be used at handling points to minimize dust; covers on equipment and connections should be as tight as possible.

Fig. 26. Protective Dress for Handling Dry Chemicals

When working with substances such as alum, lime, and soda ash, workmen should wear a cap, chemical (dustproof) goggles, a chemical dust mask, heavy gloves, and loose, long-sleeve clothing.

9. The proper individual protective measures should be taken (particularly for the skin and eyes) when handling liquid solutions; face shields, boots, gloves, and a rubber apron, offer good protection from liquid splashes or sprays (Fig. 27).

First Aid

1. Skin irritations and mild burns should be treated in the same way as any acid burn: wash with plenty of warm water and soap; never allow prolonged contact of the dust with the skin; take a thorough shower as soon as permissible; for dry, cracked skin, apply a good-quality hand cream or lotion on the hands and face.

2. If aluminum or ferrous sulfate gets in the eyes, they should be washed

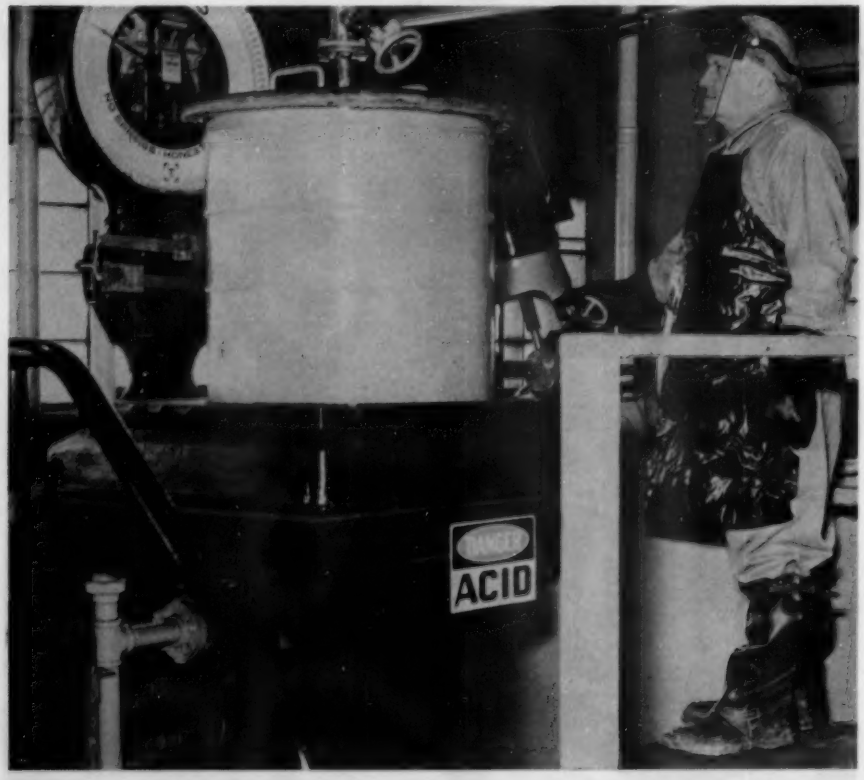

Fig. 27. Protective Equipment Against Chemical Solutions

A face shield, plastic apron, rubber gloves and boots, and loose clothing will furnish protection against chemical solutions.

10. Solution (chemical) pumps should be equipped with antisplatter shields around the stuffing box for protection of personnel against leaks (Fig. 28).

out with large quantities of warm water; if irritation continues, a physician should be consulted immediately.

3. Irritation of the mouth and nasal passages should be counteracted by irrigating them freely with warm water.

Anhydrous Ammonia

The following safety procedures should be adopted to minimize or eliminate hazards:

Handling and Storage

1. Handle cylinders and containers carefully; never drop cylinders or permit them to collide with each other; move cylinders with light hand trucks equipped with safety chains; when unloading cylinders from a truck to ground level, it is best to use a hydraulic lift gate or suitable skid with a rubber bumper at the bottom.

2. Avoid hoisting containers; if lifting is necessary, do so with safety-tested clamps or cradles; try not to use ropes, cables, and chain slings.

3. Store cylinders where heavy articles cannot fall on them and cause damage; shield the containers from mechanical disturbance or contact with moving objects.

4. Do not store ammonia near chlorine or in the same room with chlorine cylinders.

5. Store tube type cylinders (usually 1-ton containers) on their side, on a level rack or platform, with suitable blocks to keep them from rolling; place cylinders in an upright position and support them by clamps on guard chains to prevent falling.

6. Store cylinders and containers in a cool, dry place away from heat and protect them from continued dampness; do not keep them outdoors in the direct sunlight where they may become overheated. (Storage near radiators, steam pipes or other sources of heat may raise the pressure to a dangerous point, while dampness may cause excessive corrosion.)

7. When transporting containers, securely fasten them to the carrying

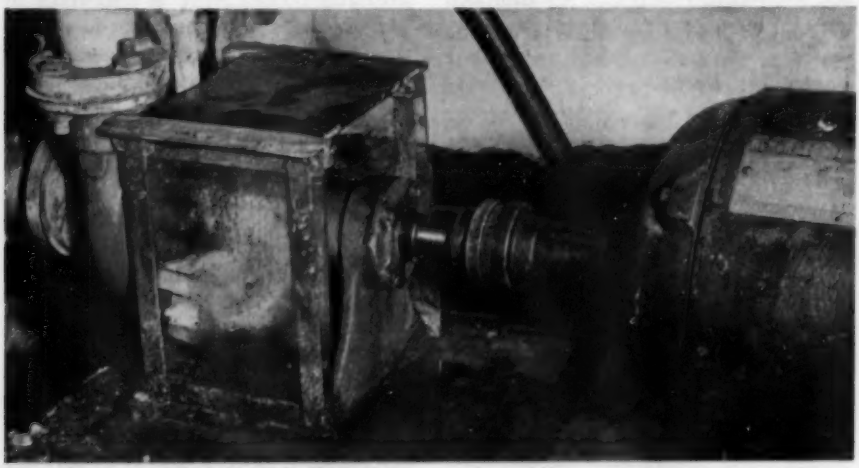

Fig. 28. Splash Shield for Chemical Solution Pump

The protective equipment is commonly made of sheet lead and glass or plastic.

vehicle, so that even under unusual strain they will not shift from their mountings or fall over.

8. Always keep the cylinder and container caps in place until they are ready to be connected, because the unloading valves are not designed to withstand accidental shocks.

9. Weigh cylinders or containers, including caps, before connection for use, and check against the gross weight shown on the tag; repeat the process when the cylinders are empty.

10. Ventilate the storage room and arrange the cylinders so that a leaking container can be removed with a minimum of handling; use fireproof storage and equipment rooms that are equipped with an exhaust ventilating system.

Controlling Leaks

1. Leaks in the ammonia valve, valve connections, ammonia feed lines, and in the ammoniator are indicated by the characteristic odor of ammonia; such discharge should receive immediate attention; the flow of ammonia should be shut off first at the container.

2. The exact location of a leak may be detected by holding an open bottle of, or a cloth swab soaked with, hydrochloric acid near the leak; a cloud of ammonium chloride mist will be generated near the discharge. (The old method of using sulfur tapers is not recommended, as they may ignite escaping ammonia.)

3. If the ammonia leak is heavy, workmen should take every precaution to avoid a flash fire or serious explosion. Ammonia gas will burn if it is blended with the proper proportion of air; the flammable limits of such a mixture are between 15 and 28 per cent of ammonia, by volume.

4. Gaseous ammonia is lighter than air and rises; therefore, ventilating systems should exhaust the air from the ceiling of a room and bring fresh air in near the floor level.

5. Only authorized persons equipped with ammonia gas masks should investigate leaks and make repairs; all others should be kept away from the affected area; such work should be done by at least two employees, with one acting as a safety man in case of an accident.

6. Cylinder or container valves should be opened slowly, and only with the special wrench provided. (Leaks around cylinder valve stems can usually be stopped by tightening the packing-gland nut, which has a left-hand thread.) It is important to use only the tools furnished by the ammonia suppliers as the leverage obtained with longer wrenches may damage the valve and make the leak worse.

7. If a serious leak develops and cannot be controlled, the container or cylinder should be dropped in a vat of water; a total of 53 lb of ammonia may be dissolved in 100 lb of water at 68°F. If there is no danger of contaminating the downwind area or endangering people, the ammonia can be discharged into the atmosphere, where it will rapidly dissipate. Water that has been used to absorb ammonia should not be discharged into separate or combined sewers, unless greatly diluted. Water from a hose may be played on the leak to absorb a considerable portion of the leaking ammonia.

8. Self-contained oxygen respirators should be used in instances of serious leaks, where oxygen may be deficient.

9. The injector type suction hose, with a large rubber funnel placed above the point of leak, will often help to control ammonia fumes while repairs are being made. (This apparatus is described above under the heading Chlorine—Controlling Leaks.)

10. Under no conditions should liquid ammonia be neutralized with an acid, because this method generates a great amount of heat and accelerates the liberation of gaseous ammonia.

11. If possible, a leaking container should be turned so that the leak is on top. In this way, only gas will be discharged and the water will have a better chance of absorbing the ammonia.

12. Shutoff valves, relief valves, and pressure-reducing valves should be made especially to handle ammonia: copper or copper-bearing fittings or valve seats should never be used, as they are subject to rapid corrosion; fittings should be extraheavy black iron or forged steel; piping should be extraheavy black iron (ASA lists specific recommendations *) on the supply side of the pressure-reducing valves and of standard black iron on the discharge side; galvanized pipe should never be used, and welded joints are preferable to threaded joints; under no circumstances should brazed joints be used, because they will deteriorate rapidly.

13. Wherever there is a possibility that an ammonia line may be closed at both ends while it is filled with liquid, the line must be protected by a hydrostatic relief valve.

14. When cylinders are manifold (set up in a battery) to increase the rate of gas flow, a check valve should be installed between each cylinder and the manifold. If this precaution is not carried out, a venturi effect created by the manifolding arrangement will result in the complete filling of one of the manifolded cylinders with liquid ammonia; if the valves are then closed, a slight increase in pressure may burst the cylinder.

15. Direct heat should never be applied to an ammonia cylinder; if it is necessary to heat it to increase the rate of withdrawal, the cylinder should be placed in a water bath; cylinders should never be exposed to temperatures of more than 110°F.

16. If a fire occurs, every effort should be made to remove the ammonia cylinders from the premises; if they cannot be taken out, the firemen should be informed of their location and contents and of the explosion hazard involved.

Gas Masks and Protective Equipment

1. Gas masks approved for protection against ammonia should be available at all times with a full face piece and green ammonia canisters or red universal canisters; these canisters will provide protection for about 15 min in ammonia concentration of 3 per cent and 5 min. in a concentration of 15 per cent; when ammonia fumes begin coming through the canister, a new one should be secured.

2. The points in an ammonia system where leaks can develop may be anticipated, and the masks and protective equipment should be placed where they can be safely reached in an emergency; the controls for the ventilating system should also be so located.

3. No one can remain in an atmosphere containing 1.5–2 per cent ammonia for longer than 15 min without developing severe skin burns. Ammonia's high solubility in water causes irritation to any skin surface where moisture has accumulated; application of petroleum jelly to neck, armpits, crotch, wrists, and ankles will provide some protection at points of perspiration.

4. Men working with ammonia and subject to exposure to the liquid or gas should wear gauntlet type rubber or

* Wrought-Steel and Wrought-Iron Pipe —ASA B36.10–1950, Am. Standards Assn., New York.

neoprene gloves, rubber aprons, gas masks, and cotton clothing and underwear.

5. When it is necessary to work on leaks where there is a high concentration of ammonia, the following protective devices should be used: a rubber or neoprene one-piece suit sealed at the ankles, wrists, and around the face and a supplied-air respirator or self-generating oxygen mask. This equipment will give good protection for about 30 min except against the freezing effect of ammonia.

6. Workmen should be thoroughly trained in the use of masks and other protective equipment and should automatically report defective gear; such devices should always be maintained in first-class condition.

First Aid

1. Ammonia that has come in contact with the skin should be removed as soon as possible; contaminated clothing should be taken off and the affected skin areas flooded with large amounts of water for 5 or 10 min; a physician should be consulted immediately.

2. Extreme care should be exercised in taking off clothing that has become frozen, as forcible removal may tear the skin; apparel may first be thawed with water at room temperature.

3. Safety showers with a capacity of at least 30 gpm should be provided; they should be located where possible ammonia fumes will not make them unusable.

4. When ammonia has been removed from the skin, the burn should be given the same treatment as any heat burn; it should be bandaged lightly and kept moist with a saturated solution of sodium thiosulfate; salves or burn ointments should not be applied until the injury is at least 24-hr old.

5. Ammonia should be removed from the eyes immediately; a treadle or brow-operated eyewash fountain should be available for this purpose; the eyes should be forced open and the lids turned back and flooded with water for 5–15 min; alternate washing with boric acid is helpful. (Any delay in such treatment may result in serious loss of vision.)

6. After injured eyes have been thoroughly washed, a physician should be consulted at once. Oil or other preparations that are not soluble in water should not be placed in the eyes. If the patient is in pain, a couple of drops of 0.5 per cent tetracaine hydrochloride ("pontocaine") may be put in the eyes.

7. Anyone overcome by an ammonia atmosphere should be removed to fresh air at once and a doctor should be summoned immediately; the patient should be kept warm with blankets and should not be allowed to get up; if he is not breathing, artificial respiration should be started.

8. Anyone exposed to ammonia who is breathing in short, shallow breaths should be completely immobilized and given oxygen; medical assistance should be obtained at once. If he has ammoniacal breath, tightness of the chest, bloodshot eyes with swollen lids, and a cough that may discharge bloody mucus, he is in a serious condition.

9. In the event that a police or fire department rescue squad is involved, make sure that a pulmotor or other mechanical means of resuscitation is not used, because such equipment may rupture the lungs of the patient.

10. Nose and throat burns should be washed thoroughly with water, then rinsed with a 2-per cent boric acid

solution; the patient should be urged to drink large amounts of milk.

11. Definite first-aid instruction should be given to all who work with ammonia; a first-aid cabinet containing all necessary supplies for treating ammonia injuries should be conveniently located in the area; this box should contain a copy of the ammonia first-aid instructions of this section, as well as a list of the names and phone numbers of available physicians.

Ammonium Sulfate—Handling and Storage

1. Ammonium sulfate should not be stored in damp or humid places because ammonia fumes will be evolved and the material will cake.

2. Ammonium sulfate should not be stored near steam pipes, hot walls, and other sources of heat; the chemical should not be placed where it can come in contact with chlorine.

3. Ammonium sulfate should never be allowed to mix with quicklime or lime dust, because such combinations can produce sufficient heat to explode; ammonium sulfate, by itself, is not explosive.

4. Ammonium sulfate should not be handled in confined areas, because it slowly emits ammonia fumes; when handling the material under dry or dusty conditions, personnel should wear chemical goggles, dust masks, and loose-fitting clothing.

5. Persons allergic to ammonia compounds should wear sufficient protective clothing to avoid bodily contact and should apply an ointment or petroleum jelly to exposed skin surfaces.

6. Eyes should be protected against splashes of ammonium sulfate solutions; if the dust or liquid gets into the eyes they should be washed immediately with large amounts of water at a drinking fountain or from a syringe. Ammonium sulfate is mildly acid, and a strong solution can cause skin irritation.

Carbon Dioxide

The following safety procedures should be adopted to minimize or eliminate hazards:

Production

1. Generating equipment should be located as near the point of application as practicable.

2. Generators and auxiliary equipment should be located in a well ventilated space large enough to permit free movement of personnel on all sides of the apparatus; explosion-proof lighting should be used, particularly if combustible gases are the source of the carbon dioxide.

3. Preventive maintenance should be carried on to ensure that the system will always be free from leaks and that all safety devices and alarms will function properly.

4. The premises should be kept continually clean; smoking should be prohibited in areas where combustible gas is present.

Compressor and Blower

1. The compressor should have an adequate supply of free air.

2. Equipment should be provided with suitable guards to prevent injury from moving parts and burns from hot surfaces; electric interlocks to prevent removal of guards while compressors and blowers are operating may be advisable in some installations.

3. Compressors and blowers should not be serviced while they are in motion; if circumstances demand such servicing, lubricators should be ex-

tended to remove the possibility of injury from moving parts.

4. All materials, such as wiping rags, paper, and other light objects, should be kept away from compressor air intakes.

5. It is important that all excelsior and other filter material that are removed from scrubbers be taken to a safe location and destroyed.

Ventilation

1. All parts of the installation should be in well ventilated spaces, to reduce the danger in the event of leaks.

2. Adequate venting of the carbonation basin or chamber is necessary to prevent excess back pressure in lines. (Such protection is particularly important in the submerged-combustion carbonator units.)

3. Extreme care should be taken in dealing with the danger of carbon monoxide, the greatest hazard in the generation and handling of carbon dioxide. A very toxic gas, carbon monoxide is a product of incomplete combustion. If coke is used for carbon dioxide generation, carbon monoxide is always present in the gas, especially if the percentage of carbon dioxide is high (above 16 per cent). The US Public Health Service indicates: *

> The maximal permissible concentration of carbon monoxide in air is accepted as 100 ppm or 0.01 per cent by volume (0.11 mg/l at 25°C and 760 mm Hg) with atmospheric oxygen not below 19 volumes per cent (at 25°C and 760 mm Hg) for exposures not exceeding a total of 8 hr per day and as 400 ppm or 0.04 per cent by volume (0.46 mg/l at 25°C and 760 mg Hg) for exposures not exceeding a total of 1 hr daily. It should be emphasized that with concentrations greater than 100 ppm, increased physical activity, increased humidity, increased carbon dioxide concentration in the atmospheric air, or decreased concentration of oxygen increase the toxicity of carbon monoxide so that the toxic effects may result more readily from exposure to such concentrations.

4. If the plant design is such that recarbonation of the water must be carried out in enclosed, covered basins, after dewatering them for the purpose of cleaning or making repairs, they must be very thoroughly ventilated and the atmosphere in these basins, and in any others to which they are connected and which have been dewatered at the same time, must be tested and shown to be below the maximum permissible concentration before workmen are allowed to enter. A suitable carbon monoxide tester should be used for this purpose.† Until the concentration of carbon monoxide is within the permissible limits, anyone entering the basins must wear an appropriate gas mask.

5. Carbon dioxide gas, heavier than air, has almost uncanny ability to flow unexpectedly to empty basins and flumes. Portable blowers with canvas ducts are very useful for ventilating such areas before and during cleaning operations. Carbon monoxide poisoning occurs almost entirely by inhalation of the gas and may come on practically without symptoms in an individual who is comparatively inactive. The most common symptoms of complete asphyxia are pounding of the heart, dull headache, flashes before the eyes, dizziness, ringing in the ears,

* Carbon Monoxide: Its Toxicity and Potential Dangers. *Public Health Reports*, Vol. 56, No. 10, p. 421, Mar. 7, 1941).

† Such equipment may be secured from the Mine Safety Appliance Co., Pittsburgh, and the Davis Engineering Equipment Co., Newark.

nausea, and sometimes (but not often) convulsions.

Chlorine

The following safety procedures should be adopted to minimize or eliminate hazards:

Handling and Storage

1. Do not handle chlorine cylinders roughly; never drop cylinders or permit one to collide with another. It is advisable to move cylinders (up to 150 lb) by means of hand trucks equipped with safety chains. Specially designed electric hoists fitted with the proper lifting bar should be used for 1-ton containers. When unloading cylinders from a truck to ground level, it is best to use a hydraulic lift gate or suitable skid with a rubber bumper at the bottom.

2. Avoid hoisting containers; if such action is necessary, work with safe lifting clamps or cradles; avoid use of ropes, cables, and chain slings. To move cylinders from storage to the place of consumption, carry them with a properly balanced hand truck, preferably with a clamp support or safety chain at least two-thirds of the way up the cylinder to hold it in place; 1-ton containers are usually handled by the same type of safety equipment used for unloading freight cars (see Fig. 29).

3. Store cylinders weighing up to 150 lb in an upright position where heavy materials cannot fall on or against them; see that the cylinders are supported so that they cannot fall over; select storage places where containers will be shielded from mechanical disturbances, especially by moving objects; do not store containers below ground level or in the chlorine-feeding room; store 1-ton cylinders on their sides on a level rack or platform with adequate safety blocks to prevent rolling.

4. Always keep the protective caps in place when the cylinders or containers are not in use and are being handled, because the discharge valves and fusible plugs are not designed to take shocks; as soon as a cylinder or container is empty and disconnected, replace the protective caps. Always tag or mark empty cylinders or containers at once; it is advisable to store full and empty containers or cylinders in different sections of the storage area to avoid confusion in handling.

5. Store chlorine containers and cylinders in a cool place and protect them from exposure to external heat sources; never permit the temperature of the contents to approach 140°F. Keep containers and cylinders that are stored out of doors away from direct exposure to the sun and the weather; maintain them in a clean condition and inspect them regularly for leakage.

6. Do not store containers or cylinders near flammable materials, nor where continuous exposure to dampness will result.

7. Make certain that the storage area is well ventilated and that containers or cylinders are so arranged that a leaking unit can be removed with the least possible handling of other containers; arrange to use a fireproof storage room equipped with an exhaust ventilating system.

8. Place containers and cylinders in the order in which they are received so that the oldest can be used first.

Controlling Leaks

1. The slightest odor of chlorine may indicate a leak and should receive immediate attention, because small leaks can grow rapidly.

2. Two men should be assigned to the repair of a chlorine leak, one acting as a safety observer.

3. Connections to the cylinder valve should be made carefully; when threaded connections are used, it should be ascertained that the threads on appliances and unions are the same as those on the container valve outlets; connections that do not fit should never be forced together as they invariably leak.

4. Unless the apparatus is designed to handle liquid chlorine, the valve of the 1-ton container should be in the proper position to withdraw gas. The two identical valves on the 1-ton container are connected to eductor pipes inside the container. When it is lying on its side and the valves are in a ver-

Fig. 20. Approved Handling Clamp and Emergency Repair Kit

One-ton chlorine cylinders are usually handled by the same equipment used to unload freight cars. The kit contains material to effect emergency repairs of leaks. A—*clamp to seal off the main valve;* B—*clamp to seal off the fusible plug;* C—*clamp to seal leak in cylinder wall.*

tical line (one above the other), the lower valve will discharge liquid chlorine and the upper valve will discharge chlorine gas from above the liquid level. Most plants using 1-ton containers have the cradles holding the containers on scales or in scale tanks 1–2 in. higher at the valve end to elevate that portion to assure that gas instead of liquid will be drawn when chlorine is taken from a full container.

5. Containers or valves should never be altered or repaired by the consumer, except for stopping gas leaks around valve stems by tightening the packing nut. The safety devices on containers should never be tampered with. The fusible plug on cylinders below the valve seat cannot be controlled by the valve. The 1-ton container is equipped with six (three on each end) fusible metal plugs designed to soften or melt between 158 and 165°F, thus, allowing the contents of the container to discharge.

6. Container valves should be opened slowly; no wrench longer than 6 in. should be used, as the employment of large wrenches or pipe wrenches will damage the valves. One complete turn of the valve stem in a counterclockwise direction will open the valve sufficiently to permit maximum discharge.

7. To test for chlorine leaks, a small cloth or swab should be attached to one end of a stick, and the material should be soaked with ammonia water (10 per cent NH_3) and applied to the suspected area. (Some operators prefer to use a small bottle fitted with an aspirator.) A white cloud of ammonium chloride will result if there is any leakage.

8. All employees handling and using chlorine should be supplied with an approved (US Bureau of Mines) chlorine gas mask and instructed in its use. A program of at least monthly chlorine gas drills should be conducted to familiarize personnel in working with the masks on and in use of chlorine leak safety devices. Gas masks, thick loose-fitting gloves, and aprons of nonporous material should be kept in lockers outside of the chlorine equipment area where they can be reached quickly in an emergency.

9. All installations using chlorine should have on hand a chlorine leak repair kit consisting of suitable clamps, drift pins, hammers, wrenches, and other tools for emergency service on cylinders where leaks cannot be otherwise stopped (see Fig. 29 and 30). Drift pins should be of brass or steel and of suitable size to fit the usual fusible plug and valve openings in cylinders and containers. Because drift pins are not suitable for packing holes in the cylinder walls, wooden plugs and clamps should be employed.

A "Solvay Kit" suitable to the local conditions should be on hand at all stations using chlorine. Three such kits are available at cost with instruction brochures that are free on request from the Solvay Process Div., Allied Chemical and Dye Corp., 61 Broadway, New York 6, N.Y. Kit *A* contains emergency devices for stopping chlorine leaks from 100- and 150-lb cylinders; kit *B*, 1-ton containers; kit *C*, 16- and 30-ton tank cars.

10. Installations using liquid chlorine should carefully evaluate the need for providing tanks in which the container may be flooded with a solution of caustic soda or alkali to a depth and volume sufficient to absorb completely the contents of the container or cylinder. The caustic soda or alkali tank should be located immediately adjacent to the area of storage or use. Such receptacles should be equipped with suitable anchor clamps to keep the chlorine cylinder or container from

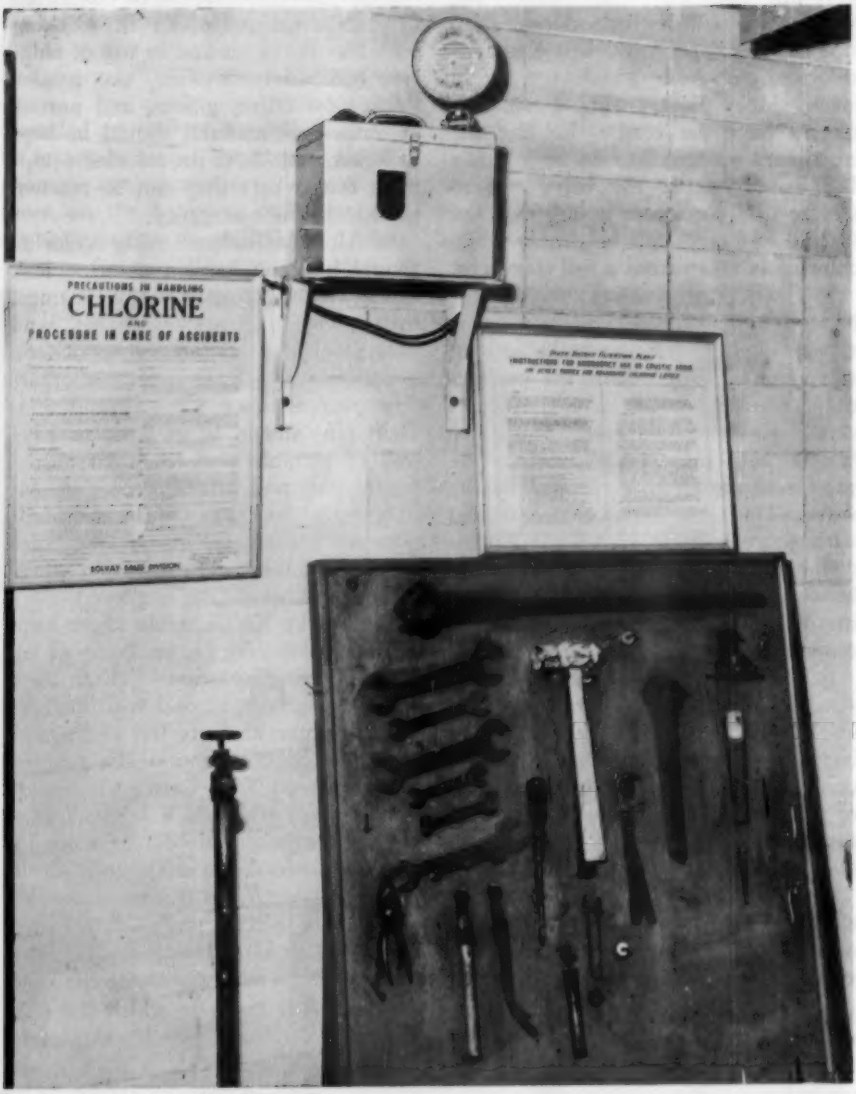

Fig. 30. Chlorine Emergency Equipment

Located just outside of the room where chlorine is used, the rack contains emergency tools for repairing leaks. Placed on the wall are instructions for taking care of chlorine accidents and handling caustic soda. An emergency portable light is ready for instant action.

floating when it is nearly empty. The degree of hazard is determined by the location of the chlorine plant and should be a deciding factor in determining the need for absorbing tanks. Where the treatment plant is isolated from built-up areas, the need for tanks is not so demanding as where the chlorine feed equipment and containers are located in an urban locality. Table 12 presents the recommended quantities of alkaline solutions for absorbing chlorine.

11. When a chlorine leak occurs, the chlorine room ventilating system should be turned on immediately.

TABLE 12

Recommended Alkaline Solutions for Absorbing Chlorine

Size of Chlorine Container	Caustic Soda		Soda Ash		Hydrated Lime†	
	Weight* lb	Vol. of Water gal	Weight lb	Vol. of Water gal	Weight lb	Vol. of Water gal
100 lb	125	40	300	100	125	125
150 lb	188	60	450	150	188	188
1 ton	2,500	800	6,000	2,000	2,500	2,500

* 100 per cent caustic soda.
† Lime slurry requires a mixing device to keep particles in suspension.

12. Only authorized and trained personnel equipped with gas masks should investigate chlorine leaks. All other persons should be kept away from the affected area. If the leak occurs on the outside of the building, everyone should stay to the windward side of the leak and, if possible, at a higher elevation.

13. When a leak occurs in equipment in which chlorine is being used, the chlorine container valves should be closed first.

14. If a leaking chlorine container is located in such a position that liquid chlorine is escaping, the container should be turned or raised so that only gaseous chlorine is discharged. The quantity of chlorine issuing from a gas leak is only about 6⅝ per cent of the amount from a liquid leak through the same size hole.

15. Water should never be applied to a chlorine leak because a hazardous condition is created and the leak will be made worse by the corrosive action of chlorine and water.

16. The use of a 2-in. water ejector connected to a high-pressure water supply system and equipped with at least a 50-ft 2-in. rubber garden hose that has an enlarged rubber funnel on the end for sucking away most of the chlorine gas from the leak should prove very helpful (Fig. 31). Discharge from the ejector can be in the raw-water channel or to a point where the chlorine water will not cause harmful conditions.

17. If dry ice is available and it can be packed around a leaking container, the rate of evaporation will be greatly retarded; if the leak cannot be stopped, the entire cylinder should be dumped in the alkaline-absorbing tank.

18. Because it is unlawful to return a leaking cylinder, its contents should be removed before shipping. The supplier of the cylinder should be immediately notified that it is defective and he should be asked to dispose of it.

19. Heat should never be applied directly to a container as it may be ruptured by internal pressures. If it is necessary to heat a container, a water bath controlled not to exceed 80°F should be used (see Sec. 23, Chlorine—Field Chlorination).

20. Grease or oil should never be used on chlorine fittings. Certain types of silicone greases may be used sparingly on valve stems and hard-rubber fittings.

21. Before disconnecting the flexible leads from containers to gas headers, the cylinder valve should be closed first and then the gas under pressure should be drawn from the header and flexible leads before the header valve is closed. The exhaust system should be turned on and operated while the

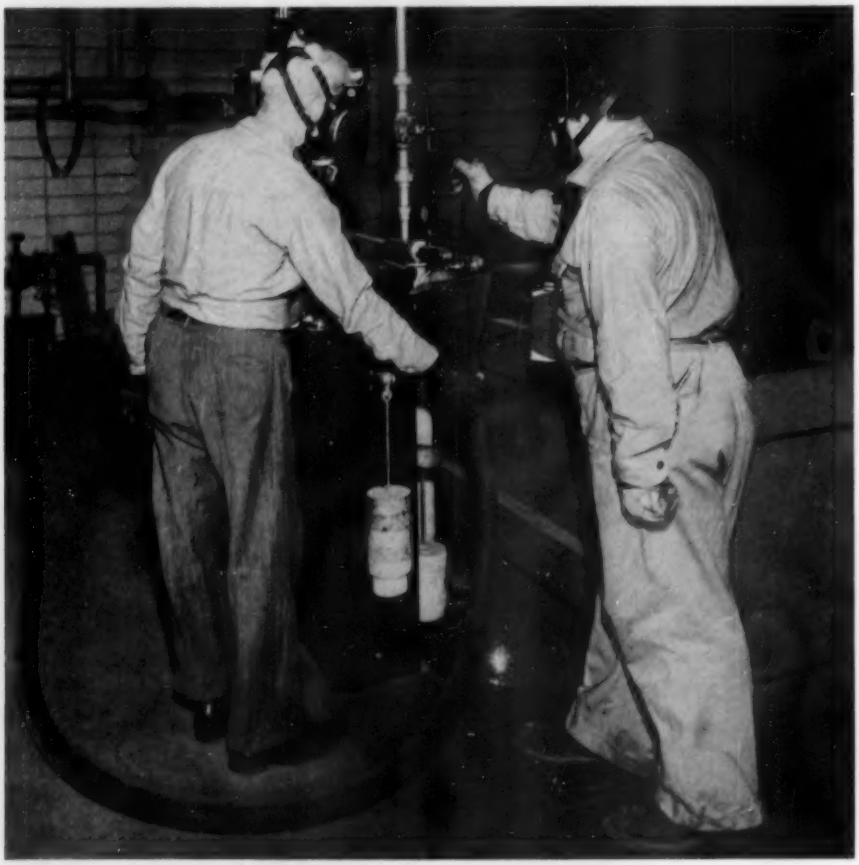

Fig. 31. Chlorine Leak Eductor

The funnel and hose draw away the chlorine gas from a small leak while repairs are made. The hose is connected to a water ejector for supplying suction at the funnel. On the floor is a grating that leads to the exhaust system.

cylinders are being disconnected and repairs are being made on chlorine lines and equipment.

22. The plastic protective cover for the rotameter tube should be in place before chlorine equipment provided with rotameters is operated.

23. If fire breaks out, every effort should be made to protect the chlorine cylinders or containers or to remove them from the danger area. Firemen should be informed of their location and poisonous nature.

Gas Masks

1. Gas masks should be equipped with full facepiece and canisters designed to cope with chlorine.

2. Canisters should be replaced with new ones every 6 months whether used or not. The canisters should be replaced immediately when there is evidence that they are exhausted.

3. Masks should be kept in cabinets located conveniently near (but not in) the chlorine room, where they may be obtained for emergency use without going through the chlorine gas area (Fig. 32).

4. Preferably a separate mask should be assigned to each employee concerned with chlorine leaks, including mechanics and pipe fitters required to work on chlorine apparatus. Only through such procedure can the mask be permanently fitted to the face of the person who will wear it, so that no time will be lost adjusting masks in an emergency.

5. One employee should be held personally responsible for records of the condition of all masks. Semimonthly gas mask drills should be held, and each employee should be required to test his mask for leaks, such as may occur through loose eyepieces, faulty tubing connections, defective or worn spots, and loose canisters.

Fig. 32. Emergency Equipment

The cabinet containing gas masks and emergency supplies is located near the entrance to the chlorine equipment and storage area.

6. Mask repairs should be made only by an employee trained for the work, and it is advisable to keep repair parts on hand for this purpose, as well as extra canisters for emergency use. Frequent inspections of each gas mask in service should be made by an employee who is properly trained to detect and discard unsafe masks.

7. For emergency use in heavy concentrations of chlorine in confined spaces, all chlorine-using installations

should have on hand either a hose mask supplied with air or a self-regenerating oxygen mask.

8. All employees should be warned that carelessness and foolhardy exposure to chlorine gas should be avoided; that no one can build up an immunity to chlorine gas.

9. If an employee is caught in a chlorine gas area without a mask, he should leave immediately, avoid panic, keep his mouth closed, refrain from coughing and deep breathing, and keep his head high as possible until fresh air is reached.

10. An adequate supply of ammonia solution (10 per cent) should be kept on hand at all times to test for chlorine leaks.

11. A copy of all chlorine safety instructions should be exhibited at some conspicuous point just outside the chlorine room and a copy should be placed in the first-aid kit.

Exhaust Ventilation

1. Each chlorinating plant or room should be provided with an adequate ventilating system that is designed for the removal of chlorine gas resulting from leakage.

2. Because chlorine gas is heavier than air and has a tendency to concentrate near the floor in the low spots of a room, the vents or grilles for removing air contaminated with chlorine should be placed in the floor or scale pits or as near the floor as possible. Such openings should be near the center of the room or at the end of the room opposite the entrance. The exhausts from this system should go out through the roof or to a suitable outside location. Exhausts should never be situated near other ventilating systems. Motors and fans for the installation should be stationed outside the chlorine room, preferably on an upper level.

3. Every employee using or handling chlorine should be familiar with the location of the switches for starting the ventilating system in the plant. These should be convenient to, but outside of, the rooms where chlorine equipment is used and should be clearly marked with large lettered signs and directional arrows.

4. Chlorine ventilating systems should be not be provided with covers, which must be removed before the ventilating system can be effective; exhaust openings should be so located that covers are not required.

5. Ventilation can be provided with a combination fresh-air and exhaust system consisting of fans that force fresh air into the room through openings near the ceiling and other fans that draw off chlorine-contaminated air in the room through vents in the floor. Such installations should be designed with sufficient capacity to provide a complete air change in the chlorine room at least every 3 min. The inlet and exhaust fans should be coupled electrically so that failure of the exhaust fan will not cause the inlet fan to blow the chlorine gas to other rooms in the building.

6. Frequent drills should be held for all employees concerned with handling ventilating systems, and equipment should not only be maintained in good condition, but tests should be conducted to see that all apparatus is operating properly.

7. Room arrangement is a prime function of personnel safety and equipment protection. If a choice of arrangement is available, the chlorine room should be constructed so it can be entered only from the outside of the building. There should be no interconnecting door between the chlorine

storage area or the chlorine feeders and the rest of the plant.

Room Temperature

1. If the chlorine scale room is separate from the chlorine feeder room, the air temperature in the latter should be about 5°F higher than that in the former.

2. Lower temperatures in feeding equipment may cause condensation of the gas to form liquid chlorine, creating trouble with the feeding equipment. The so-called "slugs" of liquid chlorine have been known to burst rotameter tubes and thin-walled gas lines on feeders.

3. Temperatures in chlorine equipment rooms or buildings should be maintained between 70° and 80°F.

First Aid

1. Remove the injured employee at once to the open air away from chlorine fumes.

2. Call a physician immediately.

3. Place the patient flat on his back, with his head and back slightly elevated; supply blankets if necessary; keep him warm and quiet, because rest is essential.

4. Because splashes of liquid chlorine and chlorinated water destroy clothing and may cause irritation and acid burns, remove or cut away affected clothing.

5. If the patient is unconscious and breathing has apparently ceased, start artificial respiration immediately. Call the fire department rescue squad, if such emergency aid is available, but be sure that pulmotor or other mechanical means of resuscitation is not used, because of the danger of rupturing the lungs. The patient may be greatly aided by the application of oxygen with proper equipment.

6. If the patient is conscious, have him drink one of these: hot, black coffee; ½ teaspoon of essence of peppermint in ½ glass of hot water; a moderate dose of "Bromo Seltzer." Milk may be given in milder cases as a relief from throat irritation.

7. Do not give the patient alcoholic drinks, as these have harmful effects.

8. If the eyes are slightly irritated, wash them with boric acid.

9. To aid skin affected by liquid chlorine, neutralize with a weak solution of sodium bicarbonate and apply loose dressings of a standard burn ointment or carron oil.

10. To relieve the nose and throat and to reduce coughing and difficulty in breathing, inhale the steam from boiling water to which 1 teaspoon of tincture of benzoin has been added or ½ teaspoon bicarbonate of soda, ½ teaspoon aromatic spirits of ammonia, and 4 drops of chloroform. Repeat the dose in 1 hr if needed. Resist, as much as possible, the impulse to cough.

11. Post a copy of first-aid instructions in a conspicuous place near the first-aid kit and be sure that proper first-aid supplies are kept on hand in a convenient location for emergency use.

Field Chlorination

1. Know the rules and regulations for the safe handling of chlorine and first-aid treatment for chlorine gassing.

2. Check and make sure that the gas mask and all other safety equipment is present.

3. If possible, set up equipment for water main disinfection a safe distance (at least 100 yd) from the nearest occupied building.

4. Observe all safety precautions in connecting chlorine apparatus and equipment, and use approved chlorine fittings.

5. Make certain that hoses are in good condition before connecting them to the cylinder and the main.

6. Be sure that the water in the main is flushing before the chlorine is added.

7. After the equipment is connected, open the chlorine valve of the cylinder and test for leaks.

8. Open rotameter or gas header valve and again test for leaks.

9. In order to avoid water backup into the chlorine apparatus and the cylinder when a vacuum chlorinator is not being used, make sure that the chlorine tank pressure is approximately 25 psi more than the operating pressure desired; also, be certain that the operating pressure is approximately 5 psi more than the backpressure from the water main.

10. After all equipment is tested for pressure and leaks, proceed to open the discharge valve and adjust the feed for proper operation; continue testing for leaks while disinfecting.

11. Never attempt to repair a chlorine hose with tape or clamps; always use a new replacement. Hose should be pressure-tested with CO_2 and kept dry. Obstructions or kinks in a hose line may cause it to burst.

12. When it is necessary, particularly in cold weather, to raise the temperature of chlorine cylinders to increase the gas pressure, they should be heated in a suitable iron drum that is kept approximately half full of water. Cylinders should not rest on the bottom of the drum, but in a cradle or stand that will hold them at least 3 in. above the bottom of the drum. Apply heat by torches or other equipment to the bottom of the drum only. Do not allow the temperature of the water bath to exceed 70–80°F. Keep the cylinder of heating gas on the windward side and at least 10 ft away from the chlorination equipment (see Fig. 33).

13. Equip field chlorinating equipment with proper pressure gages so that hose lines and lightweight connections are not subjected to excessive pressures. The procedure of connecting a chlorine cylinder directly to a corporation cock is very unsafe.

14. After the proper dosage is obtained, shut off the chlorine gas at the tank and keep the main flushing valve open for not more than 1 min. If the vacuum apparatus is not being used, it is advisable to flush the hose and equipment immediately with carbon dioxide gas before shutting the corporation cock and disconnecting the hose.

Fig. 33. Typical Field Chlorination Equipment

The fuel container is located at a safe distance (at least 10 ft) from the heating drum.

15. Watch out for a chlorine gas pocket in the main when removing the

silver delivery tube from the corporation cock; wear a gas mask when performing this operation.

16. During chlorination, check a hydrant or a suitable sampling place ahead of the point of chlorination for possible backup of chlorinated water in the main.

17. Take every precaution to prevent chlorine fumes from escaping to the air, particularly in residential areas. If the foregoing precautions are observed and direct gas feed equipment is properly flushed with carbon dioxide before disconnection, there should be no noticeable release of chlorine.

18. When using high-test hypochlorites for solution feeding, wear rubber gloves and aprons, a dusk mask, and goggles or a face shield. If a considerable amount of dust arises, wear a chlorine gas mask.

19. Use caution in handling high-test hypochlorites, both dry and liquid. Protect the eyes and do not breathe hypochlorite dust. Remove clothing immediately if it becomes contaminated with these materials.

20. Use proper warning devices to keep unauthorized persons away from the area.

21. Have gas masks and other protective and first-aid equipment ready at all times on the windward side of the chlorination apparatus.

Fluorides

The following safety procedures should be adopted to minimize or eliminate hazards:

Handling and Storage

1. All personnel handling fluorides should be given detailed safety instructions. These precautionary measures should be taken: avoid breathing fluoride dust, wash thoroughly after handling fluorides, clean up spillage.

2. Respirators, chemical goggles, and protective clothing should be worn by all personnel handling or exposed to sodium fluoride or sodium silicofluoride dust. The wearing of rubber gloves is also necessary. Rubber boots and acid-proof aprons are necessary where such acids as hydrofluoric, fluosilicic, and hydrofluosilicic are handled. Protective equipment should be washed thoroughly before and after using.

3. Care should be taken to prevent dust or acids from entering open cuts, sores, or lesions.

4. All fluoride-handling equipment, such as storage bunkers, weight hoppers, and dry-feed machines, should be provided with devices to keep the dust hazard at a minimum. Acid pumps should be furnished with clear plastic shields around glands and parts to protect personnel from acid spray.

5. Fluorides should be stored in an area specifically designed for that purpose. Storage in various or changing locations may result in a mistake in the identity of the chemical. All acid containers should be covered, well vented, and stored where there is no fire hazard.

6. Containers that have held fluoride compounds should be disposed of in a safe manner by personnel protected as described above.

First Aid

1. For internal poisoning, have the patient drink, as soon as possible, a glass of lime water (saturated solution of calcium hydroxide) or a 1 per cent solution of calcium chloride or a large quantity of milk.

2. For external injuries, wash the affected areas with large amounts of warm water.

3. For eyes affected by the chemicals, flush immediately with warm water, and then consult a doctor.

Lime

The following safety procedures should be adopted to minimize or eliminate hazards:

Handling and Storage

1. Quicklime is similar in action to that of a strong caustic and may be regarded primarily as an irritant. Persons exposed to dust should be protected with chemical goggles and suitable dust masks because lime is very irritating to the eyes, mucous membranes, and upper respiratory tract and can cause lung damage after prolonged exposure.

2. Quicklime should be stored in a dry place where it will not be exposed to moisture. This chemical has a great affinity for water and a great deal of heat is evolved when the two come in contact. Storage under damp conditions may start fires in nearby flammable materials.

3. Dry quicklime should never be mixed with dry alum or similar materials, because the lime has a great affinity for water and, when mixed with such substances in certain preparations, the reaction of the quicklime with the water of hydration (18 H_2O in the case of alum) will generate heat and cause an explosion in confined spaces.

4. Proper clothing should be worn to protect the skin as much as possible. Sufficient contact with lime dust can cause dermatitis or skin burns, particularly at points of perspiration.

5. Even in the absence of dust, protective clothing should be worn for protection if bags break or the dust collection system fails. The proper dress for handling lime is heavy denim clothing with long sleeves, bandannas, trousers tied around the shoe tops. Exposed skin areas, such as the hands and neck, should be covered with a protective cream. When clothing is permeated with lime dust or splattered with liquid lime, it should be removed immediately and thoroughly laundered.

6. An efficient dust-collecting system should be used whenever dust is present at handling points. A dry-pickup vacuum cleaner should be employed for removing dust around unloading equipment and slakers.

7. Personnel should be instructed always to take a thorough shower immediately following the handling of quicklime, whether there was dust present or not.

8. Workmen should always wear chemical goggles or face shields when inspecting or operating lime slakers, because spattering of the hot lime suspension can cause severe burns and eye injuries. The hot mist from lime slakers is also dangerous, as it usually carries lime dust.

9. The water supply to lime slakers should be closely watched, as an interruption of the water supply to a slaker while lime continues to feed may create explosive temperatures. A dial thermometer, properly located, or a temperature-sensitive warning device should be standard equipment.

10. It should be known that hydrated lime has a less caustic reaction and is, therefore, less irritating to the skin but can cause serious injury to the eyes. In the form of dust, however, this material is considered to be as important an industrial hazard as quicklime, and dust masks and chemical goggles should be worn.

First Aid

1. Lime burns should be treated in the same way as any caustic burn, by thorough washing alternately with a mild acetic acid solution and large quantities of soap and water.

2. If the eyes are involved, they should be immediately washed with a large amount of warm water, followed with a boric acid solution; a physician should be consulted immediately. Spattering of liquid-lime slurry into the eyes should be treated at once, as serious injury can be done in a few minutes.

3. If irritation of the throat and nasal passages occurs because of prolonged exposure to lime dust, a physician should be consulted immediately.

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Accidents don't happen—they are caused.

Soda Ash

The following safety procedures should be adopted to minimize or eliminate hazards:

Handling and Storage

1. Soda ash containers should be stored in a cool, dry place where they will not be subject to moisture, as such conditions cause caking, which leads to difficulties in handling.

2. Equipment for handling soda ash should include ventilating and dust collection systems at points where dust is in evidence.

3. Personnel exposed to dusts or mists of soda ash should wear protective equipment. Gasproof chemical safety goggles should be used for eye protection, as well as a close-fitting dust respirator and proper protective clothing to avoid skin contact. Inasmuch as light soda ash (made by the ammonia process) usually emits a slight amount of ammonia, persons allergic to ammonia compounds should take the same precautions recommended in the handling of ammonium sulfate.

4. Exposed skin surfaces, such as the hands and neck, should be treated with a suitable cream or petroleum jelly to minimize effects from soda ash dust.

5. The precautions taken against dust should also be used when handling soda ash solutions. Goggles or face shields and rubber aprons, gloves, and boots should be worn if conditions warrant.

6. Pumps and equipment handling soda ash solutions should be equipped with suitable spray or splash guards for protection of personnel. Danger points and soda ash storage areas should be marked with warning signs.

First Aid

1. Soda ash in finely divided form, such as dust or the mist of concentrated solutions, is intensely irritating to the respiratory tract and mucous

membranes in general. This material is particularly irritating to the eyes; prolonged exposure can cause ulceration of the nasal passages.

2. If soda ash solution is spilled on someone, it should be washed away at once with large quantities of water.

3. If soda ash dust or solution contaminates clothing, it should be removed immediately and washed before reuse.

4. If soda ash dust or solution gets into the eyes, they should be irrigated immediately with warm water for at least 15 min. If the exposure was severe, a physician should be consulted at once.

5. A physician should be consulted if the dust or mist has been inhaled into the nose and upper respiratory tract; gargling or spraying with warm water will reduce the irritation.

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Tentative

Standard Specifications

for

LIQUID SODIUM SILICATE

These "Specifications for Liquid Sodium Silicate" are based upon the best known experience and are intended for use under normal conditions. They are not designed for use under all conditions and the advisability of use of the material herein specified in any water treatment plant must be subjected to review by the chemist or engineer responsible for operations in the locality concerned.

Approved as "Tentative" Aug. 5, 1955

● Price of reprint—20¢ per copy

● Approximate date available—Jan. 1, 1956

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Tentative Standard Specifications for

Liquid Sodium Silicate

Part A—Material Specifications

Sec. 1A—Scope

These specifications cover sodium silicate which is used in the preparation of activated silica for the treatment of municipal and industrial water supplies and for the control of corrosion in water systems. The specifications are intended for use in connection with Part B (Sampling, Inspection, Packing, and Marking) and Part C (Testing Methods) of this document.

Sec. 2A—Definition

Sodium silicate is a solution of sodium oxide and silica. It is usually manufactured by melting together a mixture of soda ash and sand, and is generally furnished as a viscous, very strongly alkaline liquid. The solution varies in composition with respect to the ratio between sodium oxide and silica, as well as in density. It is readily decomposed by acids and acid-forming substances with the separation of silicic acid.

Sec. 3A—Uses

3A.1. To prepare activated silica (employed in water treatment as a coagulant aid) from sodium silicate, any one of the following may be used: sulfuric acid, aluminum sulfate, chlorine, ammonium salts, and carbon dioxide. For proper preparation and best results, the instructions of the manufacturer and experienced operators should be carefully followed.

3A.2. Sodium silicate may be added to water for the purpose of reducing corrosion. Sodium oxide and carbon dioxide are partially neutralized, and a film containing silica is deposited on metal surfaces.

Sec. 4A—Sampling

Sampling shall be conducted in accordance with Part B (Sampling, Inspection, Packing, and Marking) of this document.

Sec. 5A—Methods of Testing

The laboratory examination shall be carried out in accordance with Part C (Testing Methods) of this document.

Sec. 6A—Impurities

The sodium silicate supplied under these specifications shall contain no mineral or organic substances in quantities that would be injurious to the health of those consuming any water which is treated with activated silica or sodium silicate.

Sec. 7A—Rejection

7A.1. Notice of dissatisfaction with a shipment based on these specifications must be in the hands of the consignor within 10 days after receipt of the shipment at the point of destination. If the consignor desires a retest, he shall notify the consignee within 5 days of receipt of notice of dissatisfaction. Upon receipt of the request for a retest, the consignee shall forward to the consignor one of the sealed samples taken as described in Part B. In the event that the results obtained by the consignor, on retesting, do not agree with the results obtained by the consignee, the other sealed sample shall be forwarded unopened, for analysis, to a laboratory agreed upon by both parties. The results obtained by the referee shall be accepted as final, and the cost of the referee analysis shall

be paid by the party whose results show the greatest discrepancy from the referee analysis.

7A.2. On the basis of the retest or referee test, the consignor may remove the material from the premises of the consignee, or a price adjustment may be agreed upon by the consignor and consignee.

Sec. 8A—Physical Requirements

8A.1. The sodium silicate shall contain not more than 0.5 per cent by weight of suspended matter.

8A.2. The specific gravity of the liquid sodium silicate shall not be less than 1.380 at 60°F for the 40° Baumé grade.

Sec. 9A—Chemical Requirements

9A.1. The sodium silicate shall contain not less than 28.0 per cent by weight of silica as SiO_2 for the 40° Baumé grade.

9A.2. The ratio of Na_2O to SiO_2 is usually 1:3.25 (± 0.03). The SiO_2 shall not be less than 3.15 in this ratio.

NOTE: By agreement between the manufacturer and the purchaser, material varying with regard to specific gravity, Na_2O-SiO_2 ratio, and silica content may be furnished.

Part B—Sampling, Inspection, Packing, and Marking

Sec. 1B—Scope

These procedures for sampling, inspection, packing, weighing, and marking of sodium silicate are intended for use with Part A (Material Specifications) and Part C (Testing Methods) of this document.

Sec. 2B—Sampling

2B.1. Samples shall be taken at the point of destination.

2B.2. Samples shall be taken from 5 per cent or more of the containers.

2B.3. Full containers shall be thoroughly mixed by rolling or other suitable means. When sampling a tank car or tank truck, at least five different portions shall be taken, well distributed in depth and area or at timed intervals during dicharge, in order to obtain a representative sample. These portions shall be mixed in a clean, dry glass container to give a gross sample of at least 3-qt volume.

Three individual samples shall be poured from the freshly mixed gross sample into clean, dry, wide-mouthed glass containers with a minimum capacity of 1 pint. Screw caps will not be used. Mason jars with spring-lever closure and rubber gasket are satisfactory. These shall be marked "Supplier's Sample," "Purchaser's Sample," and "Referee Sample" and labeled for full identification. Each label shall be signed by the sampler.

2B.4. All samples shall be held for at least 30 days.

Sec. 3B—Packing and Shipping

3B.1. Packing and shipping of all sodium silicate shall conform to the current regulations of the Interstate Commerce Commission.

3B.2. Liquid sodium silicate may be shipped in properly treated wooden barrels, steel drums, tank cars, or tank trucks. It may also be shipped in glass carboys. In cold weather, it may be necessary to warm the liquid so that it will flow.

3B.3. The net weight of the containers shall be not less than the recorded weight nor more than 10 per cent greater. If exception is taken to the

weight of the material received, it shall be based on the certified weight of not less than 10 per cent of the containers, selected at random from the entire shipment.

Sec. 4B—Marking

Each shipment shall carry with it a clear identification of the material. Each unit package shall have legibly marked thereon the net weight or volume of the contents, the name of the manufacturer, the lot number, and the brand name, if any. The container may also bear the statement, "Guaranteed by (name of manufacturer) to meet the specifications (code designation of specifications) of the American Water Works Association," provided that the requirements of this document for physical and chemical quality are met and the material is *not* of a different quality in separate agreement between the vendor and purchaser

Part C—Testing Methods

Sec. 1C—Scope

These methods for the examination of liquid sodium silicate are intended for use with Part A (Material Specifications) and Part B (Sampling, Inspection, Packing, and Marking) of this document.

Sec. 2C—Sampling

2C.1. Sampling shall be conducted in accordance with Part B (Sampling, Inspection, Packing, and Marking) of this document.

2C.2. The sample of sodium silicate shall be kept in a cool, dry place and shall be kept covered except when portions are removed for testing. The sample shall be thoroughly mixed before each portion is removed.

2C.3. The laboratory examination shall be completed within five working days after receipt of the shipment.

Sec. 3C—Suspended Matter

3C.1—*Apparatus and Reagents:*

(a) Porous porcelain filter crucible, medium porosity

(b) Distilled water

(c) 50-ml beaker

(d) 10-ml pipet

(e) 400-ml beaker.

3C.2—*Procedure:*

Weigh 10.0 g of the well mixed sample from a pipet into a 50-ml beaker. Add distilled water, mix by swirling, and transfer to a 400-ml beaker with a stream of water from a wash bottle. Stir well and filter with suction through a tared porous porcelain filter crucible. Police both beakers thoroughly and wash into crucible. Wash ten times with distilled water. Make filtrate up to 500 ml in distilled water for use in the determination of silica and sodium oxide. Bake at 105°–120°C for 1 hr, cool in a desiccator, and weigh. Calculate suspended matter.

Weight increase, in grams, multiplied by ten equals per cent suspended matter.

Sec. 4C—Specific Gravity

4C.1—*Apparatus:*

(a) Glass cylinder of sufficient size to accommodate hydrometer

(b) Glass hydrometer, approximately 14 in. long, manufactured and graduated in accordance with the requirements of the National Bureau of Standards, scaled in 0.001 divisions and calibrated at 60°F (this is a short-range hydrometer with a maximum range of 0.07, that is, 1.35–1.42 sp gr, and with a minimum of 4¾ in. between these points.

4C.2—*Procedure:*

Pour enough sodium silicate sample from the bottle into the glass cylinder to float the hydrometer, with at least 1-in. clearance from the bottom of the cylinder, and place in a water bath maintained at 60°F for 1 hr. The cylinder should be kept covered when the hydrometer is not in use. Lower the hydrometer gently into the sample and allow it to sink the last ½ in. of its own weight. If it drops too low and wets the stem above the final reading mark, remove, rinse well, wipe clean at that point, and reread. Take the reading after two successive 1-min periods have shown no change.

4C.3—*Alternate Procedure:*

Proceed as in Sec. 4C.2 above, except that the hydrometer reading is taken at ambient temperature, but above 60°F. Temperatures at the top and bottom of the liquid sodium silicate in the hydrometer jar are taken before and after the hydrometer reading. Where the sample is protected from heating and cooling and the temperatures at top and bottom differ less than 1°C, with less than 1°C change in 30 min, the water bath may be omitted.

Correct the hydrometer readings to 60°F (15.6°C) by adding 0.001 for each 3.6°F (2.0°C) above 60°F at which the reading is taken.

Sec. 5C—Silica (SiO_2)

5C.1—*Reagents:*

(a) Concentrated hydrochloric acid, cp, meeting American Chemical Society (ACS) specifications

(b) Concentrated sulfuric acid, cp, meeting ACS specifications

(c) Concentrated hydrofluoric acid, cp, meeting ACS specifications.

5C.2—*Procedure:*

Pipet 50 ml of the filtrate of Sec. 3C.2 (10.0 g in 500 ml) into a 100-ml porcelain evaporating dish, on a steam bath, after adding 10 ml concentrated HCl. Mix with a short glass rod, rinse into sample, and evaporate to complete dryness.

After 10 min more on the steam bath, cover the dish and add 5 ml concentrated HCl. Rinse and remove cover. Disintegrate mass with stirring rod, and continue heating until only silica remains undissolved. Transfer to 9-cm filter paper (medium), rinse evaporating dish and wash precipitate and filter paper eight times with warm 5 per cent HCl from a wash bottle. Give a final rinse with water.

Return the filtrate and washings to the same evaporating dish used above in portions, evaporate to complete dryness, and bake for ½ hr at 105°C.

Filter through a fresh filter paper as above, adding 2 ml concentrated HCl on the steam bath. Police evaporating dish thoroughly and wash eight times with warm 1 per cent HCl and finally once with warm water.

Place both filter papers containing the precipitates obtained above in a tared platinum crucible, cover, heat very slowly to dry, remove cover, and char and burn off filter paper, avoiding any flaming of the paper. Recover, ignite at full heat of burner (preferably at 1,200°C) in a furnace, cool, and weigh.

Remove cover and add 1 ml water, 5 drops 50 per cent H_2SO_4, and about 5 ml HF (to previously determined depth in the crucible). Evaporate liquid without boiling, in a hood. When dry, blast for 15 min at full heat, cool, and weigh. The silica is volatilized by HF.

Loss in weight times 100 equals per cent SiO_2.

Sec. 5C.3—*Alternate Procedure:*

Follow procedure in Sec. 5C.2, omitting HF evaporation. Gain in weight times 100 equals per cent SiO_2.

Sec. 6C—Silica—Alternate Method *

6C.1—*Reagents:* †

(a) Thymol blue, 0.08 per cent (dissolve 0.4 g in 10 ml 5 per cent NaOH in pyrex beaker; dilute to about 250 ml; add dilute HCl to orange color, no excess; dilute to 500 ml)

(b) Hydrochloric acid, 10 per cent by volume

(c) Hydrochloric acid, 50 per cent by volume

(d) Acetic acid, 33 per cent by volume

(e) Ammonium molybdate (dissolve 50 g $(NH_4)_6Mo_7O_{24}\cdot 4H_2O$ in distilled water, total volume 500 ml; let stand 24 hr; filter; use within 1 week)

(f) 8-hydroxyquinoline ("oxine") (dissolve 14 g oxine in 10 ml 6*N* HCl; dilute to 100 ml; filter; dilute to 1 liter)

(g) Saturated wash solution (precipitate about six portions of silica as described below and filter; add portions of the unwashed precipitate to about 800 ml of distilled water containing 6 ml glacial acetic acid and 71.5 ml concentrated HCl per liter, until an excess remains after 10 min of boiling (reflux); let stand overnight and filter just before use).

6C.2—*Procedure:*

Pipet 50 ml of the filtrate of Sec. 3C.2 (10.0 g in 500 ml) into a 500-ml volumetric flask, make up to volume, and mix well. Pipet 50.2-ml portions of this for test without delay.

To the 50.2-ml portion contained in a 400-ml pyrex beaker, add 8 drops of thymol blue, followed by concentrated HCl dropwise until the color changes to red. Add the following successively with vigorous stirring, continuing for 1 min after the last addition: 8 ml 10 per cent HCl, 5 ml 33 per cent acetic acid, and 20 ml ammonium molybdate.

After 15 min, add 40 ml 50 per cent HCl, followed at once by 60 ml oxine from a buret, with stirring. Cover the beaker, and heat on a water bath to 60°C for 10 min, with occasional stirring. Cool rapidly, allow precipitate to settle, and decant through a weighed porous porcelain crucible (medium) with suction. Wash twice by decantation, ten times with wash solution, and once with 5 ml cold distilled water. Dry 1 hr at 140°C. Place porcelain cover on crucible before removing from oven, and put into desiccator. Weigh rapidly, when cool, with cover in place. Run a distilled water blank.

6C.3—*Calculation:*

Weight of oxine salt of molybdisilicic acid times 0.0251 equals weight of SiO_2.

When 50.2 ml portion is taken:

$$\frac{\text{mg of precipitate} - \text{mg of blank precipitate}}{40} = \text{per cent } SiO_2$$

Sec. 7C—Sodium Oxide

7C.1—*Reagents:* ‡

(a) 0.100*N* hydrochloric or sulfuric acid

(b) methyl orange indicator solution.

7C.2—*Procedure:*

Pipet 50.0-ml portions of the filtrate obtained in Sec. 3C.2 into a 250-ml Ehrlenmeyer flask. Titrate to the methyl orange endpoint with 0.100*N* hydrochloric or sulfuric acid.

7C.3—*Calculation:*

$$\text{ml acid} \times 0.31 = \text{per cent } SiO_2.$$

* Adapted from "Determination of Silica," by J. A. Brabson *et al.*, *Analytical Chemistry*, Vol. 20, p. 504 (Jun. 1948).

† All reagents ACS analytical grade.

‡ ACS reagent grade.

Using Aqua Nuchar

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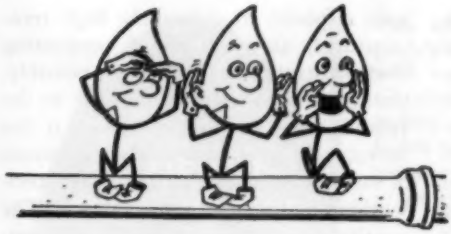

Percolation and Runoff

Automation—the technique of making a process fully automatic—has been burgeoning in the field of manufacturing for a good many years. Actually, according to Anderson Ashburn, an editor of *American Machinist*, the word itself was born only 8 years ago, but the practice is about 175 years old, having been started back in the 1780's when Oliver Evans of Philadelphia designed and built a grist mill that was automatic from the unloading of the grain to the barreling of the flour. Meanwhile, what made the grist mill run was getting along without any automation of its own until the automatic controls for individual pumping, treatment, and distribution facilities and processes began to become more and more complicated and coordinated. Even so, the only real water system automation of which we have yet heard is that at Falkirk, Scotland, where a 12-mgd supply, treated by one of the few rapid sand filter plants in Britain, takes care of itself from source to tap, starting up and shutting down as required by the demand and washing the filters as loss of head indicates they need it. A plant to make any operator's mouth—well—water, according to AWWA Secretary Harry Jordan, who saw it on a two-week tour of British water plants last July, following the London meeting of the International Water Supply Assn.

Basic reason for the reluctance of water works men to turn to full automation has been the public health, the one responsibility they most hesitate to entrust to assistants that are not only immune but completely insensible. Their reluctance is, of course, understandable, though not necessarily entirely justified. Many of our current automatic operations, properly supervised, are more reliable than a good many of the men for whom they would be substituted if health authorities permitted. And with the tools of automation improving as rapidly as the water works personnel situation disimproves, the day will not be too long coming when the routines of water works operation can be electronically programmed, leaving to the human agents supervision of the robots, emergency operation and control, and, of course, attendance at AWWA meetings.

As a matter of fact, with no more basic scientific equipment than now is available, it should be possible not only to automaticize the collection, treatment, and delivery of water, but the commercial aspects of the business as well. Certainly it is not difficult to

(*Continued on page 36 P&R*)

(Continued from page 35 P&R)

imagine meters that can transmit their readings back to utility headquarters and, there, at prescribed intervals, automatically issue the proper bills. True, that task has long been handled automatically in the gas business in Britain by nothing more complicated than a coin-operated meter, but, for the water business, today's electronic tools ought to be able to provide something a little less suggestive of the pay toilet. At any rate, if the accomplishments of electronics in other fields are any guide, there are few water works jobs of any classification to which the principles of automation could not be applied. In such engineering tasks as the installation of new mains where and when they are required, automaticity does seem a little improbable, but only in the provision of new customers are we willing to call it—and to help keep it—impossible.

Another milestone—or, perhaps, millstone—for both the Southwest Section and AWWA breezed by in the heat of last August, when the Southwest stole a lap on California in the membership race, thus making it possible for AWWA to welcome its second thousand-member section. As of the end of August, the count was: California Section 1,262, Southwest Section 1,020, putting the latter 50 members closer to the top than it was at the end of last year.

In congratulating the Southwest on this further step toward becoming the Southbest, we're inclined to wonder just how long the Northeast is going to be content as the Northleast.

And now chloridation—i.e., the addition of small quantities of sodium chloride to the drinking water of persons exposed to extremely high temperatures, as a means of preventing heat prostration. Credit—or, possibly, blame—for this innovation goes to the Inland Steel Co., which found it the surest way to overcome the resistance of some of its more individualistic steelworkers to taking salt tablets. The results of a dose so small that employees do not notice the taste has been the end of heat prostration cases.

The advantage of Inland's position as a chloridater over that of communities which fluoridate is, basically, the paycheck—which suggests that "mass medication" depends primarily on who is working for whom.

The Denver Water Board has created the post of project engineer within the Denver Water System. First to fill the position is Earl L. Mosley, former secretary-manager of the board. Succeeding him as secretary-manager is Robert S. Millar, former assistant manager, who came to Denver in February 1955 from Wichita, Kan.

The Phillenium is here! The City of Brotherly Love has finally decided to expend some of its filial fondness on its most important servant—the public water supply. The notoriety that so long plagued Philadelphia water may not always have been deserved, but it most certainly existed, and among the foremost to bring it into existence and to keep it there was the Philadelphia *Inquirer*. Thus, that newspaper's Jul. 19 editorial, entitled "A Thing of the Past: That Evil-Tasting Water," must have tasted especially sweet to Water Commissioner Sam Baxter and Gen. Supt. Gerry Arnold. "The achievement," as the *Inquirer* acknowledges,

(Continued on page 38 P&R)

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Yes, efficient flocculation is primarily a problem of correct baffling. Rex® Floctrol, with its unique combination of fixed and circular rotating baffles (*see illustration*), makes possible more thorough mixing, holds short circuiting to a minimum and assures efficient flocculation. Use of Floctrol in the pre-treatment stage often means considerably greater plant capacity without construction of additional facilities. With Rex Floctrol you get these outstanding advantages:

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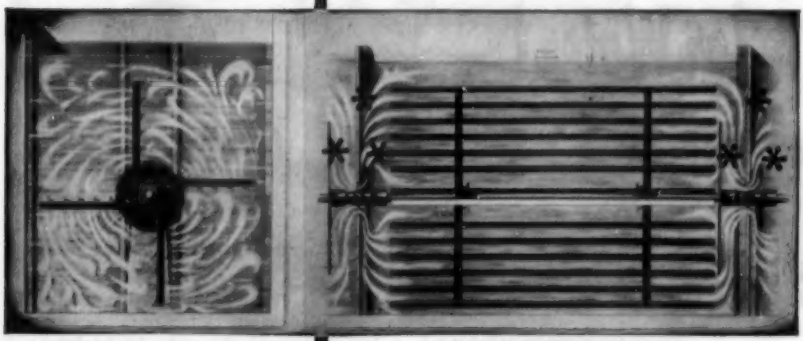
For all the facts, call your nearest Rex Field Sales Engineer or write for Bulletin 48-39. Chain Belt Company, 4609 W. Greenfield Ave., Milwaukee 1, Wis.



Cross-sectional view from head of tank showing mixing action.

Cross-sectional side view of Floctrol showing flow.

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District Sales Offices in All Principal Cities

(Continued from page 36 P&R)

"represents 45 years of planning and building to improve the quality of our water supply both by advanced methods of filtration and treatment and by cleaning up the supply sources in the Delaware and Schuylkill." Even so, the editorial points out that the condition which gave rise to the notoriety "has changed radically in the last few years," a specific tribute to the present water department administration.

About the only thing that the *Inquirer* missed in hailing the new order and looking forward to the future solution of problems of quantity was the passing of a simile. "Like Philadelphia water" had a worldwide meaning that even penetrated the Iron Curtain, and it's going to be anything but easy to convince non-Philadelphians that the phrase now means "pure and sweet and delicious"—a chore that should, nevertheless, serve to preserve the "Philadelphia lawyer."

William W. Aultman has returned to California to become an associate in the consulting engineer firm of James M. Montgomery. In 1951 Mr. Aultman left his post as purification engineer of the Metropolitan Water Dist. of Southern California to become assistant director of the Miami, Fla., Dept. of Water & Sewers. Late in 1954 he joined Alvord, Burdick & Howson, Chicago, on a temporary basis.

Wolverine Tube, a division of Calumet & Hecla, Inc., has opened new general sales offices in the Guardian Bldg., Detroit.

(Continued on page 40 P&R)

BUILDERS PROPELOFLO is an inexpensive main line meter for totalizing water consumption. Gives dependable, trouble-free service on the job. Meters accurately over wide range — six-digit totalizer shows water use directly in gallons, cubic feet, etc. For complete information on this easy-to-install meter, write to Builders-Providence, Inc., 365 Harris Ave., Providence 1, Rhode Island.

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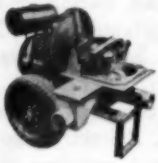

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(*Continued from page 38 P&R*)

George E. Barnes, at his own request, has been relieved of administrative responsibility as head of the Dept. of Civil Engineering & Engineering Mechanics, Case Institute of Technology, Cleveland, Ohio. A department head since 1933, he will remain on the faculty as professor of hydraulics and sanitary engineering, devoting his time to teaching, research, and consulting.

That blood is thicker than water and politics thicker than both was indicated at Wayne, W.Va., even in the hottest part of last July, when veteran water superintendent Floyd Smith left the community's 460 homes and business places high and dry because the village council delayed reemployment of his son, who had been acting as his assistant. On the morning after a council meeting at which Smith senior was reemployed and action on Smith junior's reemployment was deferred for a week, Superintendent Smith handed his son's and his own resignation to his first cousin, Mayor Charles Allen, as a protest against "politics in the water works."

With the system shut down and Cousin Floyd's refusal to reconsider his action, there was the likelihood of politicians in the water works, too. But Mayor Allen managed to get in touch with State Sanitary Engineer Harry Gidley, through whom he was able to get two men from the Huntington Water Corp. on the run. They shut the reservoir valves, started the pumps, checked the filters, and then turned the operation over to one of Wayne's former assistant water works managers, who was employed on the spot to keep things going on a 24-hr basis until the 120,000-gal reservoir was refilled.

Just how thick things did get at Wayne before they completely clogged is impossible to tell from anywhere but Wayne, but it isn't too hard to imagine political interference enough to call for drastic measures. Not against the public, though, as this was. Rather, *with* the public, toward nonpolitical control.

William P. Drake, executive vice-president of Pennsylvania Salt Mfg. Co., Philadelphia, has been named president of the firm. Mr. Drake, who has been with the company 21 years, succeeds George B. Beitzel. The latter will continue as a member of the board and, in addition, will serve as board chairman of Pennsalt International Corp., a subsidiary.

The Washington Suburban Sanitary Commission, Hyattsville, Md., has reappointed Harry B. Shaw chief engineer and has announced the following new appointments: secretary—John T. Bonifant, formerly assistant secretary-treasurer, succeeding James B. Parkhill; general counsel—Nicholas Orem, formerly with Duckett, Gill & Orem, succeeding Arthur C. Keefer; deputy chief engineer—Robert J. McLeod, formerly division engineer in charge of plans and surveys, succeeding H. Roland Devilbiss, who is retiring after 36 years of service with the commission.

Edward R. Stapley has retired as head of the Oklahoma Institute of Technology, Oklahoma A&M, and becomes dean emeritus of the institute and professor emeritus of civil engineering. Dean Stapley is credited with developing the institute into one of the leading engineering centers among the

(*Continued on page 42 P&R*)

Want cobwebs on *your* complaint phone?

Then let Calgon* solve your water problems—and you can say goodbye to complaints of lime scale and red water. Calgon not only stabilizes iron and manganese dissolved in water at its source but also prevents iron pick up from pipes—red water is stopped.

Calgon is just as effective at combating lime scale—in either naturally hard or lime softened water. Scale-forming chemicals are kept in solution, so filters, valves, mains and heaters stay clean, and flow capacities are maintained.

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(Continued from page 40 P&R)

country's land grant colleges. For his contributions to the field of municipal water supply and water works personnel training, he was given the Fuller Award in 1942 by the Southwest Section, AWWA, which also elected him chairman and director. This summer marked the completion of Dean Stapley's thirtieth year on the Oklahoma A&M faculty. He became head of the engineering division in 1942.

Activated-silica sols are prepared and fed by a continuous process in the "Model 63 Activator" developed by Omega Machine Co., Providence, R.I., a division of B-I-F Industries, Inc. The unit, which features a central control panel and sequence starting, permits a choice of reagent and variation of aging concentration and time. An antigel interlock stops activant feed if the raw silicate supply fails.

Joseph E. Johnston has been appointed director of the Div. of Sanitary Engineering, Mississippi Board of Health, succeeding the late Herbert A. Kroeze. Mr. Johnston, a public health engineer, has been with the Board of Health for 24 years.

Clinton B. Burnett has been named general manager of Johns-Manville Celite Div., New York, succeeding Arthur S. Elsenbast, who retired. Mr. Burnett continues as vice-president of Johns-Manville Products Corp.

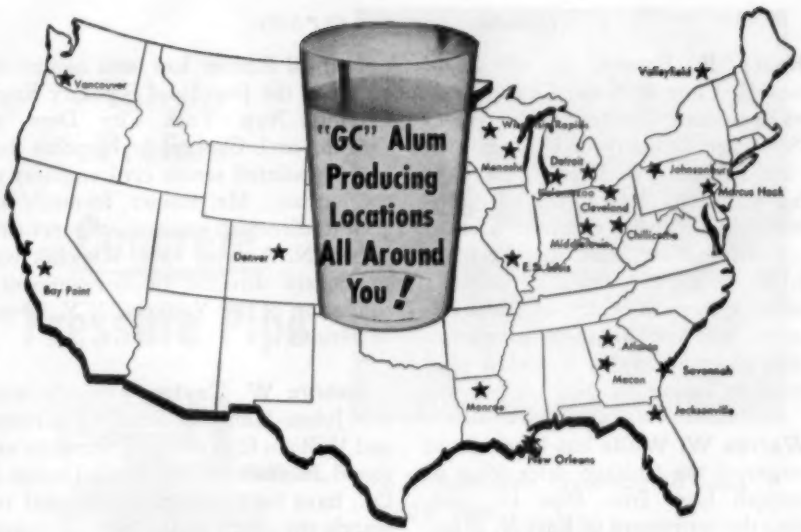
William A. Yost Jr. has been appointed to the newly created post of vice-president—staff operations, Allis-Chalmers Mfg. Co., Milwaukee, Wis. Previously Mr. Yost was vice-president, General Machinery Div., Allis-Chalmers.

Mud in the eau was the basis of a $28,000 claim against the New York State Thruway Authority last August when the city of Yonkers, N.Y., filed a complaint that Thruway construction had so muddied the Saw Mill River north of the city that it became unfit for use as a water supply for a period of six months. The amount of the claim was the cost of the water Yonkers had to purchase from the New York City system to substitute for its regular supply. How must satisfaction Yonkers will get still hasn't been revealed, but, certainly, any substantial settlement ought to help clarify the responsibility involved in the relocation of water lines to accommodate highway construction—making it, of course, as clear as mud.

Mud in the eye, meanwhile, was the cause of another water claim which finally reached a decision in the US Court of Appeals in St. Louis. There, the 2 to 1 decision that a bartender can add water to whisky in a bottle was based on the fact that the federal law forbidding the addition of "any substance" to a partly filled liquor bottle really meant by "substance" any "substance" on which a tax is due. But then, with mud in the eye, clarity comes a little difficultly too. At any rate, we're probably less concerned with this desubstantiation of water than are some of our poorest customers.

C. Scott Hoeppner has been named branch manager of Peerless Pump Div., Food Machinery & Chemical Corp., and now heads the factory sales office recently opened at 461 Market St., San Francisco. Mr. Hoeppner has been in sales engineering with the firm since 1948.

(Continued on page 44 P&R)



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GC Allied Chemical

Serving Agriculture from Coast to Coast

(Continued from page 42 P&R)

Harry F. Bower, an official of James B. Clow & Sons, Chicago, has been appointed director of the Water & Sewerage Industry & Utilities Div. of the Business & Defense Services Administration, US Dept. of Commerce. Mr. Bower succeeds Charles W. Krause, New York district manager of Neptune Meter Co., under a rotation system in which business executives are lent by their companies to the government for a period of 6 months or longer.

Warren W. Wolfe has been named manager of the Chicago sales office of American Cast Iron Pipe Co., following the retirement of Earl N. Mattson after 40 years of service with the company.

Harold Romer has been named director of the Bureau of Sanitary Engineering, New York City Dept. of Health, and George J. Kupchik has been appointed senior civil engineer of the bureau. Mr. Romer, formerly assistant director, succeeds the retiring Albert N. Aeryns. Mr. Kupchik was previously director of environmental sanitation of the Yonkers, N.Y., Dept. of Health.

George W. Taylor, formerly with the Johns-Manville Research Center, and William C. Neumann, formerly engaged in research for Stein-Davies & Co., have been appointed chemical research engineers in the Special Applications Dept. of The Permutit Co., New York.

(Continued on page 46 P&R)

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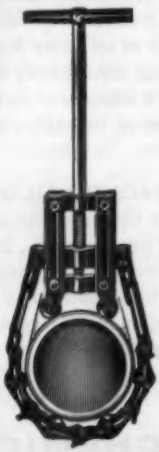

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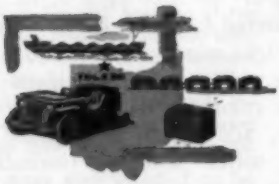
Toledo Prefers Concrete Pressure Pipe



Toledo engineers prefer concrete pressure pipe for the city's water supply mains. In 1948 an 8,600-foot installation, known as the Bancroft Street Crosstown Main, was completed. Since then 24", 36", 48" and 72" concrete pressure pipe has been used in major additions to the city's water supply system. Just recently contracts have been signed by Lucas County authorities and work is in progress on additional projects in the Toledo area, involving 16" and 24" pipe.

There are a number of reasons for Toledo's increasing use of concrete pressure pipe. Sustained high-carrying capacity and long life are two of the most important. Another is low maintenance cost. The original cost is also low and installation is accomplished quickly and easily.

Talk to Toledo engineers when you plan your next water line. You'll learn why they like concrete pressure pipe—not only for transmission lines, but for city distribution mains as well.

Member companies manufacture concrete pressure pipe in accordance with nationally recognized specifications

Concrete PRESSURE Pipe

WATER FOR GENERATIONS TO COME

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

(Continued from page 44 P&R)

C. F. Wertz has been appointed director of the Miami, Fla., Water Dept., succeeding the retiring William A. Glass, who will be retained as a consultant to the water and sewers board. Mr. Wertz has been resident engineer at Miami for Day & Zimmerman, the firm that acts for the bondholders in overseeing the water department.

Kaarlo W. Nasi, US Public Health Service sanitary engineer director, has assumed duties as assistant chief of the Water Supply & Water Pollution Control Program, Washington, D.C. Mr. Nasi has been on assignment with the Foreign Operations Administration, most recently as chief of the Far East Branch, Public Health Div., Washington.

Automatically controlled regeneration is now available in dual-tank zeolite softening units marketed by Graver Water Conditioning Co., New York. An electrical control panel containing a series of relays and a multiple-cam timer initiates regeneration of one softener at a time after a predetermined volume of raw water has entered the unit. The package unit includes panel, flowmeter, automatic multiport valve, softeners, brine-measuring tanks, and connecting lines.

Robert Brewer, California Health Dept. district sanitary engineer, San Bernardino, has been called to active duty from the US Public Health Service Commissioned Engineer Reserve. He will serve as principal sanitary engineering adviser to the director of health, as a member of the US Operations Mission to Surinam, South America.

Public Works Magazine has moved its offices from New York City to the suburbs. Its new address: 200 South Broad St., Ridgewood, N.J.

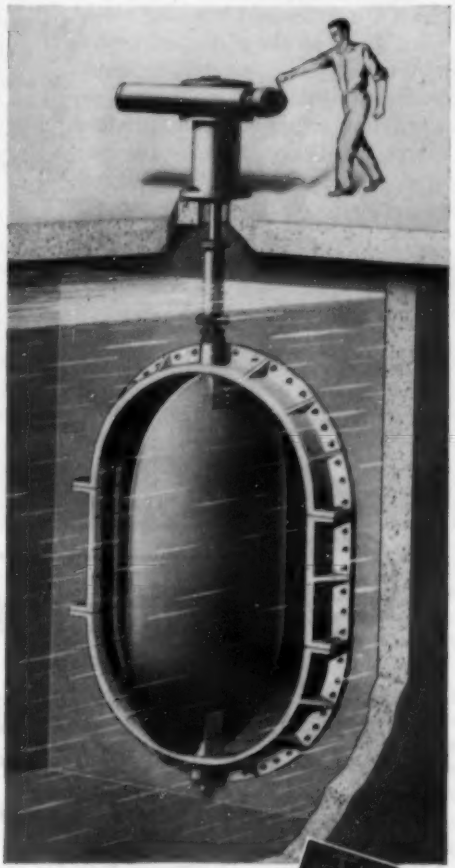
Pink, the color which has run from women's underwear to men's outerwear in the past couple of years, now appears to be spilling over on the utility field as well. Just recently, for instance, General Electric shocked us with the announcement of a new group of "de luxe pink bulbs" which, substituted for those harsh whites that now light our way, are said to "give a new radiance to complexions; enrich warm colors in fabrics, pictures, and foods; add luster to polished furniture; soften shadows [including, of course, those of the 5 o'clock variety]; and reduce glare." Already in production, these glamor globes, coated with a permanent pink enamel, were scheduled for appearance on the market in their too, too "pink, black, and white cartons and sleeves" by mid-September. Due for a somewhat later appearance, we hope, is the pink pastel paving suggested to highway authorities by a Los Angeles art expert as a means of adding not only beauty, but safety and comfort as well, to our streets and roads, primarily by cutting glare.

It may not be until after garbage trucks have succumbed to this call to the color, but one day, if its virulence in the wardrobe is any guide, pinkishness is bound to wring some concession even from the water works man. Not pink water on tap, perhaps, for the dark-pink type has already been branded a nuisance. Not pink in the sink, either, or even in the washing machine, for the detergent manufacturers have already beaten us to the

(Continued on page 48 P&R)

Butterfly Sluice Valves

Save space . . .
Fast, easy operation . . .
Save installation costs
. . . Drop tight!



No "double head room" needed. The 90° rotation of the valve disc takes place entirely within the valve body . . . no additional head room is needed. Henry Pratt Butterfly Sluice Valves are the answer to the problem of valving a large flow in a minimum space.

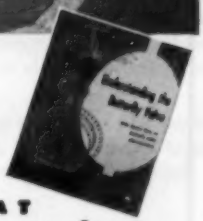
Fast, easy operation. Even the largest of these valves can be opened or closed by one man in a few minutes.

Full 90° closure into Rubber Seat. The disc is slightly larger than the inside of the rubber seat and thus actually displaces the rubber when closed. The ratio of seat thickness to disc indentation insures drop-tight shut off and avoids permanent set. The seats are secured in the valve body by removable keeper segments.

Simple, low cost installation. The entire valve is installed in one piece. There are no guide-ways to set, and thus there is no possibility for subsequent warpage to prevent tight shut-off.

Send for informative booklet

"Understanding the Butterfly Valve" Bulletin 2B



HENRY PRATT

RUBBER SEAT Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

(Continued from page 46 P&R)

hue there. But a sink in the pink, maybe, by the provision of methyl orange bath salts and the proper adjustment of chlorine residual to produce an attractive and relaxing tubful.

Whether this siege of pinkicity is just a natural reaction to the recent overdose of investigations of communist leanings, an outbreak of feminism, or merely a pale substitute for the rose-colored glasses of the 1920's we haven't quite decided. Whatever the cause, it does seem a shame that water works stand a much better chance of getting "in the pink" through psychopigmentitis than through adequate rates.

Permutit Co. of Canada Ltd. has moved its Montreal office to 5500 Royalmount Ave., Town of Mount Royal, Montreal.

Fred S. Porter has retired as division engineer of the Long Beach, Calif., Water Dept. after 33 years of service. In 1922 Mr. Porter left the field of mining engineering to join the department as a draftsman. He has since held several engineering posts there, and served as general manager from 1932 to 1940. His activities in AWWA included the chairmanship of the California Section in 1940. Mr. Porter has taken up residence in Nevada City, Calif., where he plans to establish a private engineering practice.

Frank E. Gerlitz has been named vice-president in charge of sales for the Simplex Valve & Meter Co., Lancaster, Pa. Mr. Gerlitz was formerly sales manager of the company.

(Continued on page 50 P&R)

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Sodium Fluoride—98%

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Meets AWWA specifications

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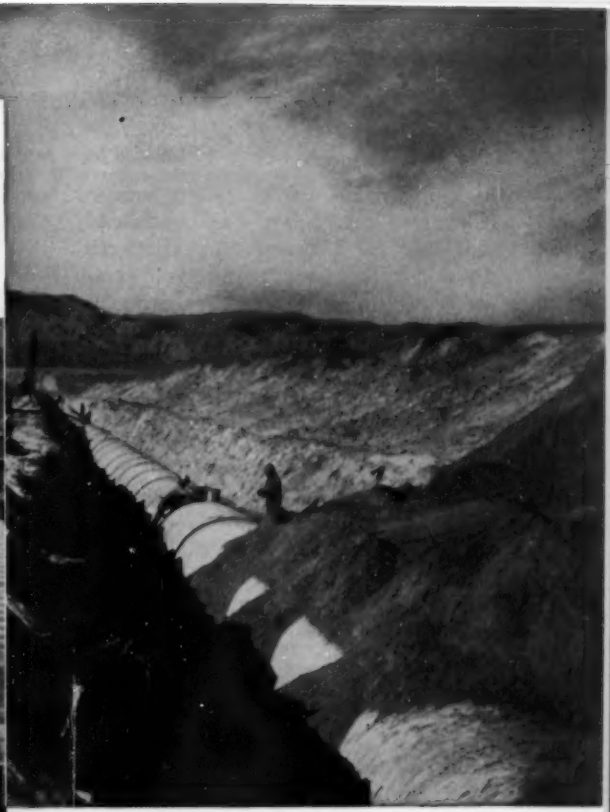

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Most job requirements can be met by existing plants strategically located throughout the West, but where distance and transportation factors exist and where the quantity of pipe involved is sufficient, it is frequently advantageous to set up pipe-making plants near the jobsite.

In the past few years American Pipe and Construction Co. has established many jobsite plants throughout the West. Substantial savings have been realized, for customers and manufacturer alike, by erecting these plants close to the project.

Wherever your next project is to be, we would like to help you plan it. An inquiry directed to any of our regional offices will receive prompt attention.

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New Bulletin No. 12

"Representative List of Installations"

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District Sales Offices and Plants: Hayward • San Diego • Portland, Ore.
Concrete pipe for main water supply lines, storm and sanitary sewers, subaqueous pipe lines

(Continued from page 48 P&R)

What price water? Right now in Cleveland it's 2,500 to 1 and in Toledo, 5,000 to 1. At any rate, those are the odds the water commissioner of each city offers to its heavy drinkers.

It was back in thirsty July in Cleveland that Commissioner Frank Schwemler sweated out the idea of pointing up a timely bargain by offering $50 out of his own pocket to anyone who could drink 2¢ worth of city water in a week. Inasmuch as 2¢ worth in Cleveland figures out to 234 gal, or just about a ton, Schwemler didn't have to stay awake nights worrying about bankruptcy, and the publicity that followed was nationwide. Then, in thirstier August in Toledo, Commissioner Sol Wittenberg upped the ante to $100, even though his 2¢ worth represents only 116 gal—2.75 qt per hour, 24 hr per day, for 7 days. That offer, too, represented a pretty safe bet, both to keep Sol solvent and to spread the water word.

As far as the publicity goes, the price is right—but what price water?

Natural resources was one of the subjects covered in the recently issued report to the President by the Commission on Intergovernmental Relations. The 25-member commission, consisting of presidential and congressional appointees prominent in government, business, and education, recommended:

. . . establishment by the Congress of a permanent Board of Coordination and Review to advise the President and the Congress on a coordinated natural resources policy within the National Government and between it and the States. The Commission further recommends that each State designate an existing agency or establish a natural resource advisory council to coordinate State policies and administration and to facilitate cooperation with Federal agencies in planning, building, and operating natural resource projects.

* * *

The Commission recommends legislative action to extend to all water development projects initiated or proposed by the National Government the requirement now contained in the Flood Control Act of 1944—that the views and recommendations of State and local agencies be taken fully into account prior to the authorization of new projects.

The Commission further recommends that agencies of the National Government afford to the States a larger measure of initiative and responsibility in multipurpose, basinwide development of water resources. There should be a balanced division of activities between the National Government and the States moving toward individual State, interstate, National-State, or National responsibility. The Board of Coordination and Review and State advisory councils should be fully used for this purpose.

* * *

The Commission recommends that agencies of the National Government, as a matter of broad general policy, observe local laws governing inland waters.

* * *

The Commission recommends that the Congress and the executive branch of the National Government adopt the policy that capital costs of multipurpose, basinwide water resource developments be equitably divided between the National Government and the States concerned, in the light of benefits received, ability to pay, and other attendant circumstances.

* * *

The Commission recommends that States vigorously enforce existing water pollution abatement laws and that they expand and improve their legislation in this field. The Commission also rec-

(Continued on page 52 P&R)

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(Continued from page 50 P&R)

ommends that, as a stimulus to further action, the National Government provide technical and financial assistance to State and interstate pollution control agencies. The Commission further recommends that study be given to the desirability of Federal financial assistance, for a limited time, to cooperative programs for the construction of pollution abatement facilities.

Ernest Nuber, sales manager of Bristol Co., Waterbury, Conn., has been promoted to general field sales manager. Mr. Nuber has been with the firm since 1929.

Charles A. Emerson, partner in the consulting engineering firm of Havens & Emerson, New York, died Aug. 24 at Orange, N.J., Memorial Hospital after a five-weeks' illness. His age was 73. Born at Beloit, Wis., in 1882, he was educated at Beloit College and Massachusetts Institute of Technology, and was a registered professional engineer in six eastern states.

From 1905 to 1910 Mr. Emerson was engaged in water and sewage engineering at Columbus, Ohio, and Baltimore, Md. For the next 12 years he served with the Pennsylvania Dept. of Health, the last nine as chief engineer. In 1923 he entered private practice as a consulting engineer, first with Fuller & McClintock, New York; then with Gascoigne & Assocs., New York; and, since 1940, with Havens & Emerson. The water and sewerage undertakings on which Mr. Emerson was a consultant had a total dollar value of about $180,000,000.

Mr. Emerson was a Life Member of AWWA, having joined in 1908. He was a past-president and one of the founders of the Federation of Sewage & Industrial Wastes Assns., as well as a member of the American Society of Civil Engineers, the American Public Health Assn., the American Public Works Assn., the National Society of Professional Engineers, and a number of local professional organizations.

Earl J. Lynde, chief sanitary engineer of the Pasadena, Calif., Water Dept., died Jul. 15 at the age of 64. Born at Sioux City, Iowa, in 1891, he was graduated with an engineering degree from the University of Nebraska. His early experience was in railroad and highway engineering, and he served for 2 years as city engineer and water and street superintendent of Sierra Madre, Calif. Mr. Lynde joined the Pasadena Water Dept. in 1923, and a few years later organized and became head of the Sanitary Section. The absence of waterborne disease in Pasadena attests to the efficiency of his work in this field. He also contributed greatly to the successful construction and operation of Morris Dam and the reservoir system.

A member of AWWA since 1941, Mr. Lynde was also active in the American Assn. of Engineers, the American Society of Civil Engineers, and the Society of American Military Engineers.

Charles M. Ledbetter, who recently retired from active duty with the Mississippi Board of Health, Jackson, died Jul. 17, after a lengthy illness. Mr. Ledbetter had been an AWWA member since 1939.

Allen-Shuff Corp., Nashville, Tenn., has been appointed sales representative for Graver Water Conditioning Co., New York, in the territory including all of eastern Arkansas, northern Mississippi, and western Tennessee from the Tennessee to the Mississippi River.

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Explanation Wanted

To the Editor:

Two or three years ago you published an article [July 1952 JOURNAL, p. 10 P&R] in reference to a pipe locator made of two pieces of bronze welding rod. Has there been any scientific study made of why such devices work?

The Niagara Mohawk Co. has them on its service trucks and ordinarily uses them in preference to an electronic finder, which has a habit of locating overhead telephone cables, guy wires, etc.

A peculiar thing is that they do not work for every person, as I have proven several times. During my recent vacation on the east end of Long Island, the owner of a small water system had a set which would not work for him. Yet I readily checked mains of whose location he was sure and found one he had lost because of highway relocation. More than that, I located a couple of asbestos mains and several plastic services. After the owner explained that the water in the pipes caused the indication, I located a gas main on the opposite side of the street from an "asbestos main."

We know that engineers and Ph.D.'s ridicule the idea, but that is not the answer as hundreds of operating men are using these devices, with accurate results. Science with the aid of research has made a wonderful advance during the last few years but some things are as yet unexplained.

R. G. YAXLEY

Waterford, N.Y.; Aug. 27, 1955

Our own explanation in the P&Rticle Mr. Yaxley cited has been the only one provided, and that, of course, was non-science. Can anyone do better?—ED.

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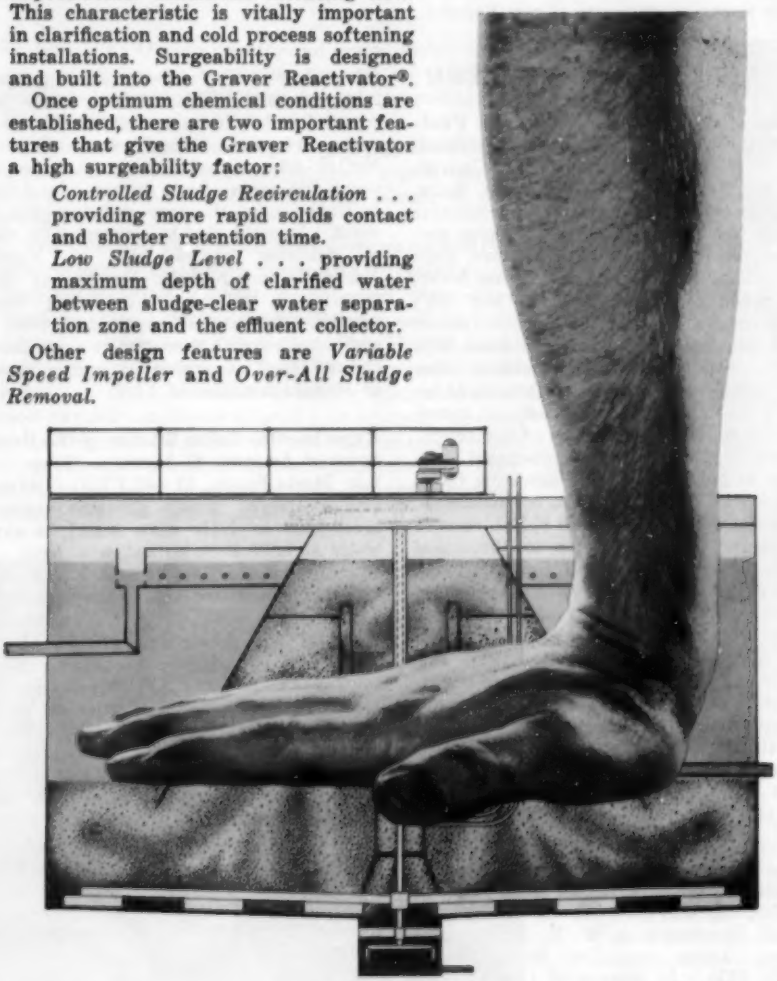

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Key: In the reference to the publication in which the abstracted article appears, **39**:473 (May '47) indicates volume 39, page 473, issue dated May 1947. If the publication is paged by the issue, **39**:5:1 (May '47) indicates volume 39, number 5, page 1, issue dated May 1947. Abbreviations following an abstract indicate that it was taken, by permission, from one of the following periodicals: *BH—Bulletin of Hygiene (Great Britain); CA—Chemical Abstracts; Corr.—Corrosion; IM—Institute of Metals (Great Britain); PHEA—Public Health Engineering Abstracts; SIW—Sewage and Industrial Wastes; WPA—Water Pollution Abstracts (Great Britain).*

BOILERS AND FEEDWATER

Influence of the Salt Content of Feedwater and Boiler Water on Salt Deposition in High-Pressure Turbines; Operating Experience With Potassium Salts. H. KUCHEN. Mitt. ver. Grosskesselbesitzer (Ger.), No. 29, p. 141 ('54). Topping turbine supplied with steam from 2 powd. coal-fired, radiant-drum boilers and 1 Benson boiler, with steam conditions 140 atm. and 500°, had to be washed every 4 days to remove heavy salt deposits, consisting of about 60% NaOH, 30% Na_2SO_4, and balance other usual boiler salts. Feedwater treatment included Na_3PO_4 and NaOH, but salt concn. in boiler water was in excess of theoretical. Possible reasons for this are discussed. Attempts to reduce concn. by increasing blowdown from 0.75 to 1.5% were not successful. Replacement of Na_3PO_4 with K_3PO_4 reduced salt concn. in boiler water to theoretical values, greatly reduced salt conc. in steam and lengthened period between washings to 2–3 mo. Boiler tube corrosion was later found, attributed to fact that supposed K_3PO_4 was actually acid mixt. of K_3PO_4 and K_2HPO_4. In meantime, boilers were altered so that it was possible to use Na_3PO_4 without appreciable salt deposition on turbines, even at high boiler water salt concns. Later, successful tests were made with K_3PO_4, to which KOH was added. Favorable American experiences with K_3PO_4 were confirmed. —*CA*

Action of Boiler Water on Steel—Attack by Bonded Oxygen. C. E. KAULFMAN, W. H. TRAUTMAN & W. R. SCHNARRENBERGER. Trans. Am. Soc. Mech. Engrs., **77**:423 ('55). In absence of DO, O combined in water may also react with steel to cause corrosion, especially under conditions where alky. of boiler water may be subject to local concn. Case histories of failures of desuperheater pipe at water level, boiler tube failure at welded joint, and superheater tube are cited. This type of failure was repeated in lab. by using steel bombs; in all cases, presence of small amt. of strong NaOH soln. served to remove oxide deposits and expose fresh surface. In absence of NaOH soln., this type of failure was not noted. It could also be prevented by addn. of oxidizing agents such as $NaNO_3$, $Na_2Cr_2O_7$, and $KMnO_4$, but use of these materials in boiler operation is not recommended. In case of superheater tube, H evolved along with formation of oxide caused embrittlement of surface in manner typical of H embrittlement.—*CA*

Experimental Boiler Studies of the Breakdown of Amines. C. JACKLIN. Trans. Am. Soc. Mech. Engrs., **77**:449 ('55). Different amines showed widely different amts. of breakdown to NH_3 when tested in exptl. boiler at 1,500 lb/sq in. and satn. temp. Of 15 materials tested, cyclohexylamine (**I**), 2-diethylaminoethanol (**II**), and morpholine (**III**) showed relatively low breakdown rates. **I** was not tested at higher temps. because its usefulness is limited by its low soly. in initially formed condensate. **II** showed good stability at 1,500 lb/sq in. and steam temps. up to 800°F. Above 800°F, amt. of breakdown to NH_3 increased rapidly. **III**, in contrast, is relatively stable at boiler pressures up to 2,500 lb/sq in. and steam temps. up to 1,200°F. Amt. of breakdown of **III** to NH_3 increases quite slowly and uniformly up to 1,200°F, highest temp. tested. Of all materials tested, **III** most nearly fulfills requirements for ideal, volatile, alk. material for pH control in steam-generating systems.—*CA*

Chemical Reactions in Steam Boilers—Reactions Between Gases and Metals and the Behavior of Sodium Hydroxide. K. WICKERT, H. PILZ & K. NOLTEN. Mitt. Ver. Grosskesselbesitzer (Ger.), No. 32, p.

(*Continued on page 64*)

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(Continued from page 62)

368 ('54). In spite of comparatively high reaction veloc. between Fe and H_2O with C steels and low-alloy steels, formation of protective coating of Fe_3O_4 after short time prevents dangerous attack. At steam temps. over 600°, protective action of Fe_3O_4 layer is no longer sufficient, and high-alloy steels must be used (as well as for required strength); these steels react with steam very slowly at high temps. Reaction of NH_3 on Fe in presence of steam is very slow and presence of NH_3 and ammoniacal compds., such as hydrazine, in boiler is harmless. Ni is not protected from destructive action of NH_3 by steam; Cu is affected by NH_3 at temps. from 400 to 850°, but its properties can be restored by heating to 900°. Very little decomposition of NH_3 occurs on Fe at 1 atm. and temps. up to 500°. Mol. H has no effect on Fe, but at H has decarbonizing effect on steels of high C content, free from protective Fe_3O_4 layer. Even large quants. of CO_2 are not dangerous in steam phase, but can cause corrosion in presence of O and liquid water; this is prevented by NH_3, if present. Mol. H can cause reduction of Na_2SO_4 with formation of H_2S, which is corrosive; Na_2SO_4 deposits in superheater and in other locations should be avoided. NaOH gives little trouble; although concd. or fused NaOH may attack Fe at high temps., little difficulty is actually encountered, owing to volatility of NaOH with steam.—*CA*

Reducing Solutions at Steam Boiler Temperatures. H. D. Ongman. Combustion, 24:8:40 ('53). Results are given of lab. investigations into relative effs. of sodium sulfite, sodium hydrogen phosphite, and hydrazine in absorbing oxygen from soln. in boiler water at high temps. Appreciable vapor pressure of sulfur dioxide exists above dilute alk. solns. of sodium sulfite in high-pressure steam boiler, but concs. of sulfur dioxide in steam can be greatly reduced by scrubbing with boiler feedwater of 8–10 pH. Sodium hydrogen phosphite is too strong reducing agent and attacks protective ferric oxide film on heating surfaces. Hydrazine oxidizes to form ammonia and nitrogen at temps. above 350°F and also is distilled with steam. Solns. of hydrazine also attack protective ferric oxide film at metal surfaces at high temps. but not to such extent as sodium hydrogen phosphite.—*WPA*

'Stalactite' Formation in a Boiler. C. H. Greener. J. Appl. Chem. (London), 3:84 ('53). Investigation has been made into formation of hollow finger-like deposits in boiler tubes. For boiler operated at pressure of 200 psi, anals. are given of raw-water supply, lime-softened water, and boiler water. After boiler had been operating for 12 mo., internal condition of boiler drum was satisfactory, but boiler tubes were covered by layer of dried sludge and hollow growths, of about ¼-in. diameter and length, were present on tops and sides of internal surfaces. There appeared to be no corrosion under stalactites, but examn. of formations showed that they consisted of inner annulus of iron oxide and outer coat of apatite. Author considers that iron compd. present in stalactites are products of corrosion. Tubular corrosion products sometimes occur when corrosion is localized by presence of inhibitor, which in this case was tannin-polyphosphate mixture.—*WPA*

Dehydrated Alfalfa Prevents Scale in Sea Water Evaporators. H. Karl, L. St. Cyr & J. Wocaser. Econ. Botany, 9:72 ('55). Expts. were conducted with synthetic sea water in exptl. evaporator with 50% blowdown. Addn. of 0.1% powd. alfalfa prevented scale formation, with evidence that as little as 0.035% would suffice. Effect was not due to change in pH, to ash constitutes, or to materials sol. in Et_2O, EtOH, or water, but seemed to be due to material sol. in alk. saline.—*CA*

Gulf States Utilities Company Demineralizes 40,000,000 Pounds of Water per Day (100 Per Cent Feed) to 1,500-psi Boilers. W. B. Gurney & C. R. Stewart. Southern Power and Ind., 72:11:58 ('54). Baton Rouge power plant delivers steam at 135-lb. gage to nearby industries, so it requires 100% makeup water. When max. boiler pressure was 600 psi, boiler feedwater was prepd. from Mississippi River water by cold pptn. with CaO and $Fe_2(SO_4)_3$, followed by filtration and Na zeolite softening. When boilers operating at 1,500 psi and 950°F were installed, this system supplied water of insufficient purity for 100% makeup, so 2-stage demineralization plant was installed for use with well water. Tests were made as to best regeneration procedure for local conditions; cation resin was regen-

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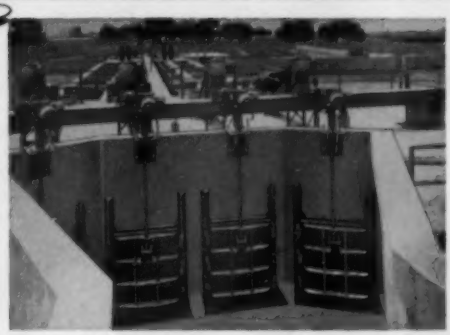

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(Continued from page 64)

erated with 2–5% H_2SO_4, followed by 10% for later part of cycle (HCl was also used in part under certain conditions). Anion-resin regeneration was first with 5% NaOH, followed by 10%. Both resins were regenerated with reagent flow of 1.2 gpm/sq ft. Regeneration control was automatic except that when HCl was used, its addn. was controlled manually. Considerable difficulty was experienced with contamn. of anion bed with Fe, Cu, and Al from influent water. Al formed flocculant ppt, while Cu and Fe coated resin. Source of these metals (piping and pump parts) was elimd. and resin replaced. Acid waste from cation-resin regeneration is partly neutralized by alk. waste from anion-resin regeneration; sludge from first-stage clarifiers in older plant is used for neutralizing remaining acidity. H_2S and other gases in well water are removed by vacuum degasifier. Treatment cost is about 6¢/1,000 gal. Expected resin capacs. were realized, and SiO_2 content of boiler water at end of prelim. tests was only 2.5 ppm, with only light blowdown. —*CA*

Acid Cleaning of Steam Boilers. J. TEN BRINK. Mitt. Ver. Grosskesselbesitzer, No. 28, p. 84 ('54). 6 boilers were acid cleaned, 4 of which had operating pressure of 18 atm., steam outlet temp. of 420°, and rating of 70,000 kg/hr. Other 2 boilers had operating pressure of 120 atm., steam temp. of 510°, and rating of 80,000 kg/hr. Mech. arrangements for carrying out treatment are described; these were given prelim. test with water before using inhibited acid soln. 2 boilers were treated at one time with partially spent acid soln. from one boiler on second. Results were satisfactory.—*CA*

Turbine Salt Deposits. E. HASS. Mitt. Ver. Grosskesselbesitzer, No. 29, p. 175 ('54). Salt deposits on high-pressure stages of turbine supplied with steam at 64 atm. and 490° accumulated so rapidly that washing was required every 2–3 wk, in spite of fact that boiler water concn. was maintained at 0.07°Bé, or below, as compared with specified max. of 0.3°Bé. Salt deposit analyzed about: 33% Na_2CO_3, 24% Na_2SiO_3, 23% Na_2SO_4, and 20% NaCl. At times, up to 3% Na_3PO_4 was also present. Boiler feedwater was treated with Na_3PO_4 in sufficient amt. to give P_2O_5 content of about 10–15 mg/l. Turbine deposits were heavier than would be expected, found due to evapn. of steam trapped in tubes of superheated-steam cooler. Salt dust was then carried over with steam. This was not found in usual anal. of steam for salt content. Excessive salt carry-over could be decreased by raising boiler water level sufficiently to wash out salt dust. Tests were made with Na_2SO_3 addns. to boiler feedwater; salt deposition became negligible until water leaks occurred in superheated-steam cooler. Later, corrosion was noted in high-pressure stages of turbine. Analysis of salt deposits showed traces of Na_2S. At temps. above about 550°, this is formed in atm. of N or pure steam by disproportionation: $4Na_2SO_3 = Na_2S + 3Na_2SO_4$. In presence of reducing substances, reaction occurs at temps. as low as 300°, and is appreciable at 480°. H_2S is evolved under these conditions. In presence of NaOH, Na_2S is formed at 400°. Even neutral salts commonly found in boiler water cause reaction to begin at 480°; reaction is appreciable at 500°. In plant mentioned above, salt deposits and corrosion occurred at about 430° on turbine rim and shaft; bucket deposits were quite thin.—*CA*

Acid Cleaning of High-Pressure Boilers at the Fortuna Power Plant. K. RUMMEL. Mitt. Ver. Grosskesselbesitzer, No. 28, p. 89 ('54). Deposits of Cu were found on interior of tubes of 80-atm. natural-circulation boiler. This prevented successful welding until deposit was removed in neighborhood of weld. No operating difficulties were caused by Cu. Later, steam decompn. products caused corrosion and cracking. Fe_3O_4 was found at corroded locality covered by layer with high Cu content. Scale removed from boiler operating at 80 atm. had following anal.: Cu 43.0, Fe_2O_3 45.1, CaO 4.8, SiO_2 1.2, and remainder (SO_3, P_2O_5) 5.9%. Tests showed that normal scale could be removed with 5% HCl and washing, but that steam decompn. products could not be removed even with 10% HCl. For that reason, boiler was treated at 30° for 6–8 hr with 5% HCl contg. 2 kg hexamethyltetramine/cu m. This successfully removed normal scale. Cu deposit on tubes did not reappear after 5 yr. Principal source of Cu had been condenser with brass tubes and these had been replaced with Al tubes. It was suggested to boiler manufacturers that

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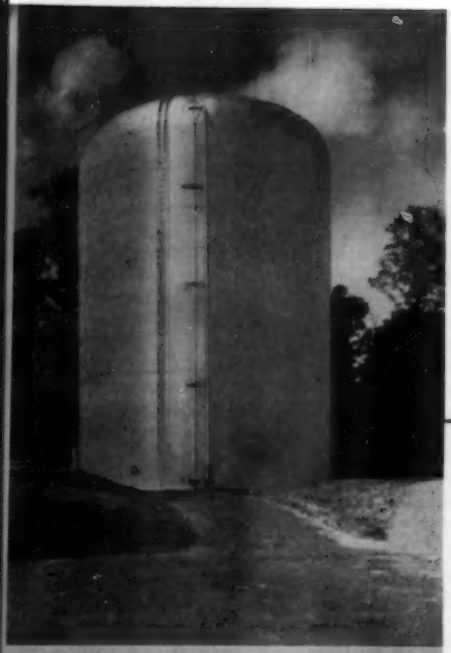

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this treatment be used to remove Fe oxides from new boilers, but manufacturers recommended repeated boiling with Na_3PO_4 at 125 atm. This did not remove iron oxides responsible for turbidity. Turbine deposits resulted from priming of boiler water due to suspended solids. Single-acid treatment caused disappearance of turbidity, but this later reappeared (owing to particles of Fe_2O_3). It appeared desirable to reduce O content of turbine condensate.—*CA*

The Behavior of Brass Tubes (Ms 63) in a Condenser at the Hamburg Electric Works. H. KIEKENBERG. Mitt. Ver. Grosskesselbesitzer, No. 29, p. 169 ('54). Owing to war shortages, Ms 63% brass (63% Cu and 37% Zn) tubes were used instead of marine brass. This gave good service until recently when cond. of condensate suddenly increased. Pressure tests failed to show any pronounced leakage, but it was later found that tubes had become porous and allowed small amt. of water to pass through. This was due to dezincification with soln. of both Zn and Cu, with deposition of latter in porous form. Condensate had become acid owing to decompn. of salts carried by cooling water, so that it was necessary to treat with NaOH until tubes could be replaced with marine brass. It is suggested that tests for cond. and hardness of steam condensate should be made regularly to detect contamn., as pressure tests on condenser may fail to show this. Condenser tubes should be removed periodically and examd. to see whether dezincification, corrosion, or other changes have taken place.—*CA*

Chemical Cleaning of the Water Side of Steam Generators. G. KNAPPICH. Mitt. Ver. Grosskesselbesitzer, No. 28, p. 87 ('54). 2 boilers each rated at 32,000 kg/hr at 40 atm. and 450° were chemically cleaned to remove thin, gummy, oil-contg. scale. Only part of 1 boiler was cleaned. High-pressure feedwater heater was first cleaned with special 20% NaOH soln. at 95° for 5 hr to remove oil. This soln. was then discarded and section washed out with hot water. This exposed scale, which consisted of $CaCO_3$, Ca phosphate, with traces of rust and $CaSO_4$, and little silicic acid. This scale was sol. in proprietary acid soln. "Steintod-HT," dild. with 10 parts water. Treatment time was 3 hr. Combined alkali and acid treatments were repeated 3 times, including feedwater heater, boiler drum, and boiler tubes. This freed surfaces completely from scale. Entire cleaning process took 60 hr. Second boiler (with exception of superheater, which contained no scale) was first cleaned with 5% special NaOH soln. heated to 95°, and then with soln. of proprietary acid soln. dild. 1:6 with water; acid soln. was heated to 55°. After this soln. was drained from boiler, it was completely filled with soln. contg. ½% special NaOH soln. and ½% Na_3PO_4; this soln. was left in boiler until it was placed in operation. Cost data are given.—*CA*

Chemical and Physical Behavior of Neutral Salts in Superheated-Steam Plant Operations. K. WICKERT. Mitt. Ver. Grosskesselbesitzer, No. 28, p. 75 ('54). If mixt. of neutral salts like NaCl, Na_2SO_4, or NaOH is carried over with steam from boiler and deposits on machines like turbines, corrosion occurs, especially if m.p. of salt mixt. is lower than steam temp. Cu and its oxides, if deposited, can corrode if electron acceptors, like O or H ions, are also present. To study effect of neutral salts, mixt. of S-free Fe powder and anhyd. Na_2SO_4 was heated in dry N atm. Reduction to Na_2S took place, but no H_2S was disengaged. However, this gas developed if wet N was used. Reduction began at 300°. Presence of faint traces of H_2S was detected by using ability of sulfide S to catalyze following sluggish reaction: $2NaN_3 + I_2 = 2NaI + 3N_2$, resulting in sudden N evolution. In testing water for sulfide S, 1 ml NaOH (20%) and 2 ml $Cd(AcO)_2$ soln. were added. Ppt. was filtered off and washed with S-free water. 3 g NaN_3 was then dissolved in 100 ml 0.1*N* I soln. Drop of this reagent was brought on slide and microscopically observed if any gas developed when Cd ppt. was brought into contact with I soln. H_2S amts. of 0.5 γ/l H_2O could be detected in this way. Traces of S could thus be found in all condensates from Benson boilers. Reaction of nautral salts with water vapor in absence of Fe was also investigated. It was found that at 440° NaCl and vapor react with formation of HCl and NaOH. Latter was retained by NaCl; disengaged HCl gathered in condensate, resulting in lowering of pH. If

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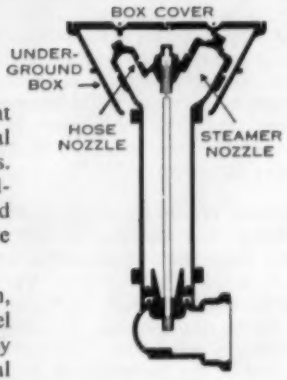

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(*Continued from page 68*)

Fe was added to NaCl, no change was observed, but SiO_2, Cu, and especially CuCl catalyzed reaction markedly.—*CA*

Chemical Purification of Carbonate Scale in Locomotive Boilers. M. A. Rozenberg, R. B. Yampol'skaya & E. I. Pogorel'skii. Nauchnye Zapiski Dnepropetrovsk. Gosudarst. Univ. (USSR), **43**:3 ('53). Removal of carbonate and mixed scale with 0.3–0.4% HCl contg. 1% dichromate was studied. Boiler was filled with water, heated to 60–70°, and dichromate and HCl were added. Temp. of 70–80° was kept for 10 hr. Treatment was very effective. Lab. study showed that loss of metal was 0.69 g/sq m/hr, indicating resistant metal.—*CA*

External or Internal Boiler Feedwater Treatment for Locomotives? W. Wisfeld. Glasers Ann., **78**:4:81 ('54). Ext. means of boiler feedwater treatment are discussed; such treatment means are rarely economical when used alone. Best soln. appears to be treatment of part of water by base exchange, and then mixing with sufficient raw water to give desired alky. Addnl. treating chemicals, chosen with respect to water anal., are added either at water supply source or to locomotive tender, to keep in suspension any sludge formed in boiler. Boiler blowdown must be provided that can be operated while locomotive is in motion. Sufficient anals. must be made of water so that treatment is adjusted to any changes in compn.—*CA*

Effects of Water Pollution in Preparation of Boiler Feedwater. H. Kohle. Bull. Centre Belge etude et document. eaux (Belgium), No. 24, p. 65 ('54). Variations in chlorides caused by mine wastes from Alsace and Baden shorten life of demineralizers. Chlorides in raw water vary from 0 to 165 ppm NaCl. By formation of HCl in upper regions of cation-exchange beds, previously fixed Ca^{++} is displaced to lower portions of exchange bed and leaks through prematurely. Remedy is to vary regeneration levels, anticipating changing pattern of raw water. Org. polln. causes viscous deposits in ion-exchange beds, removed only by washing with NaOCl or NaOH. When org. poln. is high, distd. water contains CO_2 and NH_3. Org. acids of humic acid type will be removed in anion-exchange beds. Distd. water contg. 0.3–0.8 ppm O consumed by $KMnO_4$ required Na_2SO_3 for removal of DO even after passing through degasifiers. Demineralized water contg. 3–5 ppm O consumed by $KMnO_4$ showed complete O removal by degasification.—*CA*

Deposits on Boiler Plant Heating Surfaces. A. G. Thomson. Eng. and Boiler House Rev. (Br.), **69**:269 ('54). Although anals. of deposits found on boiler tubes generally closely resemble that of coal ash, that found on superheater tubes contains much more sulfate and is lower melting. This melt tends to hold fly ash and build up until stoppages occur. Tests were made of reaction of SO_3 and SO_2 (contg. radioactive S) on NaCl at various temps. It was found that sulfate resulted largely from reaction of NaCl with SO_2, catalyzed by Fe_2O_3, which allowed reaction to proceed at temps. as low as 300°. Quant. formed from SO_2 was fairly const. over wide range of temp. and was not affected by catalyst. Conclusion: SO_2 was primary cause of sulfate formation.—*CA*

Occurrence of μ-Calcium Carbonate in Boiler Scale. K. V. Aubrey. Nature (Br.), **174**:81 ('54). During small-scale expts. at Fuel Research Station on effect of treatment of boiler feed water on structure of boiler scales, several deposits were examd. by x-ray diffraction. Most of deposits contained $CaCO_3$ as calcite and $CaSO_4$ as anhydrite. In deposits from one of exptl. boilers, bulk of carbonate was in rather unusual hexagonal form, μ-$CaCO_3$ (**I**) or vaterite. This overlay thin band of calcite. There were no notable differences between conditions of operation of boilers producing deposit of normal time and those producing deposit contg. **I**. Water analyses were similar as regards Ca, Mg, SO_4, silicate, total dissolved solids, total hardness, and H-ion concn. Occurrence of **I**, which is reported to be more sol. than calcite, agreed, however, with decrease recorded in total wt. of deposit in boiler and accompanying increase in dissolved solids in water removed from boiler. While **I** was being deposited, boiler water must have been supersatd. with respect to calcite. This may have been due to presence of substances repressing crystn. of less-sol. forms of carbonate. Spectrographic analysis of carbonate deposits showed that deposits contg. **I** held larger

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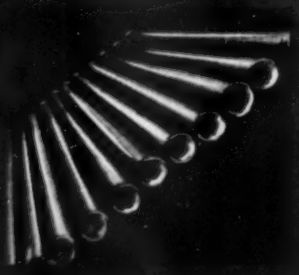

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(Continued from page 70)

quantities of Pb and smaller quantities of Sr, Mg, and Si than those which contained mainly calcite.—*CA*

Removal of Silica in Boiler Water. I. Application of Basic Magnesium Carbonate. M. AKAHANE. J. Chem. Soc. Japan, Ind. Chem. Sect., **56**:746 ('53). Reaction of water glass and basic $MgCO_3$ (I), $MgCl_2$, $ZnCl_2$, $AlCl_3$, etc., in aq. solns. of various pH was examd. at approx. 30, 100, and 195°, and amt. of SiO_2 removed with reagents was detd. With addn. of I in ratio of MgO to SiO_2 of approx. 2, max. removal (80%) was recognized at pH 10–11 at 30 and 100°. Effect of pH was not noticeable at 195°; treatments at 1.2 of MgO/SiO_2 and pH 10–11 were favorable at 195°.—*CA*

CHEMICAL ANALYSIS

Mercurimetric Method of Determination of Chlorides in Water. L. N. LAPIN & R. K. ZAVANOV. Gigiena i Sanit. (USSR), No. 10, p. 16. Simple method is described for detg. chlorides in aq. medium. Method is based on procedure described earlier in which mercurimetric detn. of Cl ion is made. Method is accurate within 0.1–0.9% (large error in soln. with about 2.2 mg/l Cl). Necessary 0.1*N* $Hg(NO_3)_2$ is prepd. by dissolving 10.9 g HgO, moistened with H_2O, in 15–20 ml concd. HNO_3 (d. 1.4) and dilg. to 1 l. Soln. is standardized against 0.01*N* KCl by treating 10-ml portion of KCl soln. with 20 ml 96% EtOH, 2 drops 1% diphenylcarbazone indicator, acidification with 2–3 drops *N* HNO_3, and titration with $Hg(NO_3)_2$ to pink-violet color. For low mineral content of waters, it is suggested that 0.01*N* $Hg(NO_3)_2$ be used. Cyanides, chromates, and thiocyanates interfere.—*CA*

The Precise and Routine Potentiometric Determination of the Chlorinity of Sea Water. J. M. BATHER & J. P. RILEY. J. Cons. Int. Explor. Mer, **18**:277 ('53). Potentiometric method for detg. chlorinity of sea water is described. 15-ml sample of sea water is weighed and dilt. with 20 ml distd. water. Magic-eye valve voltmeter used to indicate end point is set by means of potentiometer at 0.135 v, potential of platinum electrode at end point during titration of chloride with silver nitrate. Aq. silver nitrate (0.2173*N*) is added until magic eye begins to close; then more dilute silver nitrate soln. (0.004346*N*) is added until shadow lines become parallel at end point. Detns. made with sea water of std. strength have shown std. deviation is about 0.005%. Method should not be applied to samples having pH value of less than 6.5. Diagram is given of elec. circuit.—*WPA*

Determination of Very Small Amounts of Copper in Industrial Water Supplies. A. GUBIN ET AL. Mitt. Ver. Grosskesselbesitzer, No. 33, p. 435 ('55). Cooperating labs. used Zimmermann modification of diethyldithiocarbamate method for the anal. of 10 water samples contg. 0–50 γ Cu/l. As results varied somewhat between labs., second set of samples were prepd. by different lab. with new Jena glass flasks. Results were much better; investigation showed that discrepancies in first series was probably due to variable adsorption of Cu on walls of sample bottles. As result, modified method was worked out in which special flask, calibrated at 500 cc, was used. This was first washed out with 50 ml HNO_3 and then with Cu-free water. Sample of exactly 500 cc water was taken in this flask and immediately acidified with 5 ml HNO_3. Following reagents were then added: 5 ml citric acid soln. (200 g in 1,000 ml distd. water); 15 ml NH_4OH (10%); and 2.5 ml NH_4Cl soln. (200 g in 1,000 ml water). Separatory funnel was then attached and 10 ml chloroform added, and soln. shaken by hand and in mech. shaker for 15 min (with emulsion formation). Soln. was allowed to settle, and $CHCl_3$ drawn off and discarded. 15 ml of diethyldithiocarbamate soln. (1 g in 1,000 ml distd. water) and 12 ml of chloroform were added and soln. shaken as before. Chloroform soln. was then sepd. and filtered through dry paper filter into flask with ground stopper. Cu content in this soln. was detd. colorimetrically or photometrically.—*CA*

Spectrophotometric Determination of Fluoride Ion with Chrome Azurol S. D. REVINSON & J. H. HARLEY. Anal. Chem., **25**:794 ('53). Spectrophotometric method described for detg. fluoride ions in alk. soln. Thorium ions form lake with dye Chrome Azurol S, full color development of which is inhibited by fluoride ions. Factors affecting method were studied. It was found

(Continued on page 74)

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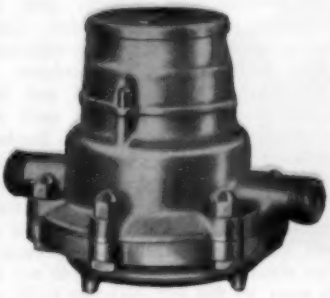

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(Continued from page 72)

that color intensity increased with increasing concn. of sodium chloride. Max. intensity was obtained in presence of at least 0.5*M* sodium perchlorate and at pH 4.5. Buffers contg. carbonyl groups bleached soln. but *o*-toluidine was satisfactory. Color intensity increased with increasing buffer concn. There was optimum concn. of thorium nitrate. Gum arabic was added to stabilize lake. Absorption was measured at 650 mμ, as this is in region of max. sensitivity for fluoride. Procedure for detg. fluorides in samples of river water, which involves prelim. acidification of sample with perchloric acid and steam distn. of hydrogen fluoride, is described. Information is given on interfering effect of large amts. of various anions. From 5μg to 90 μg fluoride may be deted. with relative accuracy of 10%. —*WPA*

The Determination of Fluorides in Main Water—Modification of the Willard and Horton Method. J. Bouman. Chem. Weekblad (Neth.), **51**:33 ('55). Method based on formation of strong fluorescent Al-morin complex in alc. to which fluoride ion is added. Decrease in fluorescence is measure of F^- content. F can be detected in 0.25 ml main water with precision of ± 0.02 γ/ml by using following modification: alc. concn. is reduced to 10% and pH soln. changed to 4.4; buffer soln. concn. is reduced to 0.25, ice-cooled and double-distd. solns. are used. To remove heavy-metal ions and Cl interferences, F can be distd. as HF prior to application of above method. —*CA*

Determination of Water Hardness by the Method of Wartha-Pfeiffer. J. O. Pastor. Farm. nueva (Spain), **19**:493 ('54). $CO_3^=$ (**I**), HCO_3^- (**II**), total (**III**), and permanent alkys. (**IV**) are detd. as follows: neutralize 100 ml of H_2O with *a* ml 0.1*N* HCl to phenolphthalein to give **I**, and then with *b* ml of 0.1*N* HCl to methyl orange; then transfer soln. to 250-ml volumetric flask, add known excess (25–30 ml) of 1:1 mixt. of 0.1*N* NaOH and 0.1*N* Na_2CO_3, and, after 3 min, dil. mixt. to vol. Titrate 100 ml of clear filtrate or supernatant with 0.1*N* HCl and calc. *c* ml for entire amt. **II** = $(b - a)$ ml, **III** = $(b + a)$ ml, and **IV** = $[(b + a) - c]$ ml.—*CA*

Determination of Water Hardness by a Complexometric Method. F. Huber & O. Schmied. Mitt. Versuchssta. Garungsgewerbe, **8**:128 ('54). Method is described for detg. quantitatively total hardness of H_2O by aid of $NaOOC(HOOCCH_2)N(CH_2)_2N(CH_2COOH)COONa$ (**I**). To det. total hardness, mix 100 cc of sample with 2 ml borate buffer (41% 0.1*N* NaOH and 59% 0.2*M* Na borate) and small amt. of chromogen black (1:200 with NaCl) as indicator. Titrate red-violet soln. with Plexochrom A (**II**) (soln. of **I**, 1 ml of which corresponds to 5.6 German degrees of hardness in 100-ml sample) until color changes to pure blue. Overtitration is indicated by green-blue color. I (ml) times 5.6 equals total hardness in German degrees. To det. Ca hardness, mix 100 ml of sample with 2 ml 1*N* NaOH, add small amt. of murexide (1:200 with NaCl), and titrate until color stability with **II**; color changes from pink to violet. Calcn. is same as above. Ca hardness subtracted from total hardness gives Mg hardness. In first test, slowly titrate 50 ml and then quickly carry out final titration until just before probable end point. To det. hardness of Mg-free H_2O, add 2 ml of 0.01*M* $ZnCl_2$ soln. to sample; then subtract 0.2 cc from amt. of **II** consumed. **II** soln. is controlled and regulated by std. $CaCO_3$ soln. Cu, Fe, and Mn ions may disturb when present in too high concns.; SO_4^{--} and Cl^- do not disturb in amts. up to 1,000, NO_3^- up to 50, and PO_4^{3-} up to 25 mg/l. Solns. can be dild. in case of too high concns. of foreign ions, or these can be masked by complex formation. Approx. 10 min is required for 1 detn. —*CA*

Determination of the Hydrogen Concentration of Steam. E. Ulrich. Mitt. Ver. Grosskesselbesitzer, No. 33, p. 413 ('55). App. is described and illustrated for detn. of noncondensable gases and especially H in steam, in which steam is bubbled through condensate in container provided with cooling water coil above water surface. Before detn., this app. is freed from fixed gases by passage of steam. Definite quant. of steam (100–1,000 kg) is then passed up through condensate, and fixed gases are led through coil surrounded by warm-water jacket and into gas-collecting tube. Wt. of steam is detd. by quant. of condensate produced.

(Continued on page 76)

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(Continued from page 74)

Gas vol. is corrected to std. conditions, and O and CO_2 are detd. Larger part of remaining gas is H, but this can be detd. by combustion with O. Sample calcns. are given.—*CA*

Spectrophotometric Determination of Iron as Ferric Sulfate Complex. R. Bastian, R. Weberling & F. Palilla. Anal. Chem., 25:284 ('53). Investigation was made on ultraviolet absorption spectra of ferric sulfate and ferric perchlorate solns. to see if they could be used for anal. purposes in detg. iron. Method described is based on formation of ferric sulfate complex by addn. of sulfuric acid to perchloric acid soln. contg. iron and has been tested on samples contg. 0.04–1.5% iron. System is sensitive and stable and conforms to usual absorption laws. Effect of temp. on system can be elimd. by comparing std. solns. with sample. Interference of many metals is small and can be minimized by using portion of original sample as blank. Nitrate must be removed by fuming with perchloric acid. This treatment also removes many other anions, but not phosphate and sulfates.—*WPA*

The Nature of Iron Contained in Lake Waters. M. Tanaka. Bull. Chem. Soc. Japan, 28:89 ('54). On basis of results obtained by centrifugation and anal. methods, it is concluded that substantial portion of Fe contained near surface of lake waters is in insol. state. Dissocn. const. is less than $4.0 \sim 8.7 \times 10^{-18}$. Ratio of sol. Fe to total Fe approaches 1 with increasing depth. This indicates that Fe becomes more sol. during course of its descent in lake. In fresh-water lakes, content of ferrous Fe is highest near bottom strata and probably supplied by mud. On other hand, ferrous Fe in lower strata of lakes with brackish water is believed to result from effect of reducing bacteria on Fe descending from surface layers.—*CA*

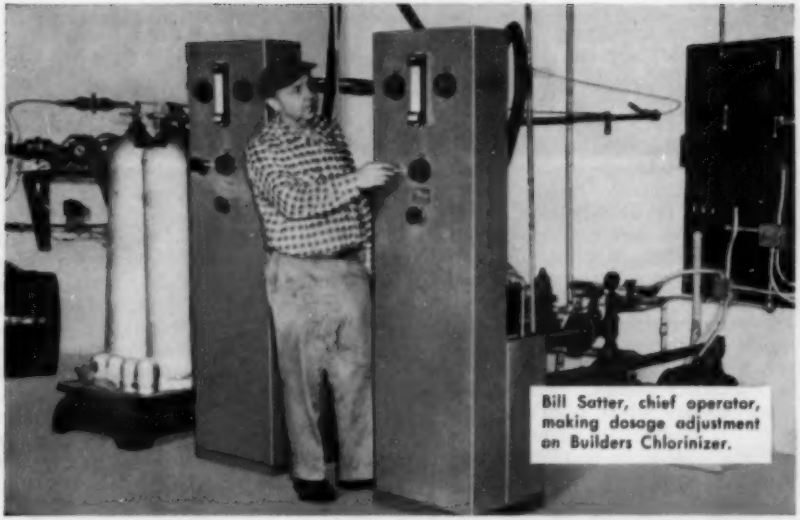
Rapid Modified Procedure for Determination of Kjeldahl Nitrogen. C. H. Perrin. Anal. Chem., 25:968 ('53). Modified procedure is described for rapid detn. of nitrogen by Kjeldahl method. Reagents used in digestion of samples are silica granules, mercuric oxide, potassium sulfate, and concd. sulfuric acid. Mixture is heated gently for 5 min and then boiled for 8–12 min. Completion of reaction is indicated by sudden clearing of soln. and noticeable reduction in rate of production of bubbles. Process differs from Wilfarth-Gunning modification in using 4 times concn. of mercuric oxide, higher temp., silica granules, and smaller quants. of other reagents. Agreement between 2 methods was within 0.3% in anals. of proteinaceous materials. New method gave more accurate results in anals. of tryptophan and nicotinic acid. Conditions under which use of copper sulfate as catalyst in place of mercuric oxide will give similar results were investigated.—*WPA*

The Determination of Oxygen in Boiler Water—The Standard Method. R. Freier. Mitt. Ver. Grosskesselbesitzer, No. 29, p. 145 (54). Oxygen in concns. of 10 γ/l can be detd. by modification of Winkler method if I equiv. to 100–200 γ O is added. To 500 ml H_2O in flask *A*, add 1.5 ml of soln. contg. 800 g $MnCl_2 \cdot 4H_2O$/l, 1.5 ml of soln. contg. 700 g KOH and 200 g KI/l, and 3 ml H_2SO_4. Add 1 g KI, 10 ml or more 0.001*N* $KMnO_4$ or I (depending on I consumption of H_2O), and 3 ml starch; titrate with 0.00625*N* thiosulfate from microburet. To 500 ml of H_2O in flask *B* add 2 ml H_2SO_4, 1 g KI, same amt. $KMnO_4$ or I added above, and 3 ml starch. Titrate; difference between no. of ml required for flask *A* and no. required for flask *B* is amt. of O in γ/l.—*CA*

The O^{18} Abundance in Fresh Water. W. Dansgaard. Geochim. et Cosmochim. Acta, 6:241 ('54). O^{18} concns. in ground, surface, and rain waters have been detd. on world-wide basis. O^{18} concn. in water vapor depends upon following parameters: [1] pptn. temp.; [2] origin of vapor; and [3] cooling experienced by vapor. O^{18} in given pptn. depends upon: [1] condensation temp.; [2] cooling since condensation occurred; and [3] amt. of evapn. water between cloud and ground. O^{18} content of ground waters is related to amt. of evapn. of pptn. and exchange of O^{18} between water and O-contg. substances in ground.—*CA*

Determination of Phenols by the *p*-nitrosodimethylaniline Method—a Discussion. I. Nusbaum. Sew. Ind. Wastes, 25:311 ('53). Author describes modification of

(Continued on page 78)



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(*Continued from page 76*)

colorimetric method for detn. of phenols by formation of indophenol as developed by Hill and Herndon. Instead of using *p*-nitrosodimethylaniline, which has to be reduced to *p*-aminodimethylaniline with sodium chloride just before use, author uses oxalate salt of *p*-aminodimethylaniline, which does not oxidize or discolor rapidly when exposed to air and does not require initial reduction. 0.1% soln. of amine salt as free base in 1% soln. of sulfuric acid remained stable indefinitely. For oxidizing agent, required to catalyse reaction, soln. of potassium ferricyanide is preferred, as it does not cause interference when present in excess and it destroys interfering sulfides. Distn. of samples is unnecessary where remaining interference is due to aromatic amines, as they can be removed by addn. of anion-exchange resin. Procedure is given.—*WPA*

Spectrographic Determination of Strontium and Lithium in Natural Waters. T. F. Borovik-Romanova, V. V. Korolev & Y. I. Kutsenko. Zhur. Anal. Khim. (USSR), **9**:265 ('54). Sr and Li were detd. in large no. of water samples of different origin. Detns. were made in fulgurator with activated a-c, 120-v arc of approx. 2 amp. Fulgurator is quartz dish 2 cm in diam. and 1 cm deep, having, at bottom, foot or holder into which fits *C* electrode. Canal drilled through axis in electrode and ending in 2 passages on either side of electrode near base serves to convey analyzed liquid by capillary force into arc. Cu spiral delivers current to base of electrode. For Sr, line 4607.331 Å was used and for Li, 6707.844 Å. Lines 4593.103 Å and 6723.279 Å were used for comparison. In samples studied, amt. of Sr found was 1×10^{-6}–1×10^{-3}%, and of Li, 1×10^{-7}–1.10^{-4}%. Ratio of Ca to Sr was indicative of origin of water, marine or continental.—*CA*

The Empirical Methods of Water Analysis and Their Value in Appraising the Content of Sewage. B. Meissner. Wasserwirtsch. Tech., **4**:166 ('54). Permanganate, BOD, Cl no., and Br no. detns. were made on about 180 chem. substances including many likely to occur in industrial or domestic sewages. Solns., suspensions, or emulsions of 0.1% concn. were used, and substances divided into 8 groups: [1] inorg. compds., [2] C compds., [3] acyclic alcs., aldehydes, ketones, and esters, [4] acyclic acids, [5] cyclic O-contg. compds., [6] cyclic N compds., [7] carbohydrates, proteins and their decompn. products, and [8] dyes. Following classes were found practically stable to std. permanganate method: [1] acyclic satd. hydrocarbons and their halogen derivs., [2] cyclic hydroçarbons except those with multi-ring systems, [3] ketones, ethers, esters, and monohydric alcs., [4] satd. acyclic acids except oxalic, [5] amino acids and amides, and [6] simple tertiary aromatic amines. Nearly all org. substances were found susceptible to at least partial biol. oxidation, exceptions being dyes and some aromatic N compds. Cl absorption follows pattern of $KMnO_4$ except that compds. contg. tertiary-bound N have no Cl absorption. Because phenols were only substances reacting positively to Br that are also likely to occur in sewages, Br no. is suggested as specific test for phenols. Permanganate values for typical sewages are given, which range from about 500 mg/g org. substance for domestic sewage and margarine factory waste to over 3,000 mg/g for paper mill wastes, slaughter house wastes, dye plant wastes, and chem. plants with wastes having a high-phenol content.—*CA*

Application of the Cation Exchangers for Water and Boiler Scale Analysis. J. Leick. Mitt. Ver. Grosskesselbesitzer, No. 28, p. 67 ('54). Total salt content and single constituents in water were detd. by passing sample through ion-exchange column and titrating acidity of effluent water with methyl orange or methyl red indicators. If soln. contd. much salt (500 mg SO_4 or Cl/l), filtration speed should not exceed 100 ml/5 min for a filter bed height of 110–150 mm. To det. phosphoric acid, only methyl red was used. Complications were caused by CO_3, SO_2, or weak org. acids. CO_2 was elimd. by boiling, which caused partial oxidation of bisulfites to bisulfates. Therefore, bisulfites should be oxidized with H_2O_2 before filtration; formed bisulfates were titrated with methyl orange as indicator. Phosphoric acid was detd. by titration according to Töller. To det. total salt content, ion-exchange column was brought into H form by washing with 200 ml HCl (20%) followed by treating with 1 l water. Sam-

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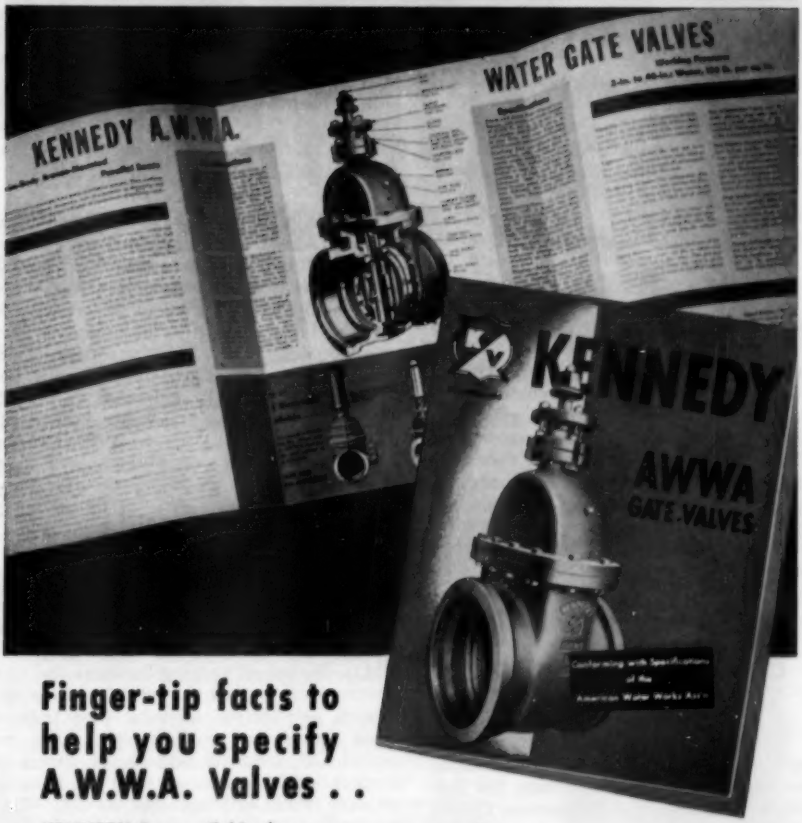

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(*Continued from page 78*)

ple was first oxidized with H_2O_2 if sulfites were present, then filtered through column with speed of 20–30 ml/min. First 100 ml filtrate was discarded. Following parts were titrated with 0.1*N* NaOH for total acid detn. In titrated sample, chlorides were detd. with $AgNO_3$ and P_2O_5 by titration. SO_4 content was calcd. by subtracting from total acid titration sum of results of Cl, P_2O_5, and SO_3 detns. To analyze boiler scale, 100 ml of scale soln. (max. free-acid content 1% and 1% total salts) was filtered over ion exchanger and washed. P_2O_5 and SO_4 were detd. gravimetrically in filtrate. Cations were eluated from column with 200 ml HCl (20%) and 300 ml wash water, and cations, such as Fe, Al, Ca, and Mg, were detd. by conventional methods. Fact that mineral salt soln. (except bicarbonates) has considerably lower cond. than corresponding acid was applied for detn. of extremely low salt concns. in water. Concentrate of water was filtered through ion-exchange column, and cond. was measured before and after this treatment. From this difference, content of $NaCl + Na_2SO_4$ was computed. Chlorides and sulfates gave almost the same change in cond. when transferred into corresponding acids by an ion-exchange column. CO_2 from bicarbonates must be completely absorbed during filtration or correction in the observed cond. has to be made. P_2O_5 and SiO_2 were detd. separately in conc.—*CA*

CHEMICAL FEEDING, CONDITIONING, AND SEDIMENTATION

Investigations on the Removal of Fluoride From Water: Factors Governing the Adsorption of Fluoride by Magnesium Oxide. P. Venkateswarlu & D. N. Rao. Indian J. Med. Research, **42**:135 ('54). Important factors are temp., duration of contact, and amt. of MgO. Thus, 2 g MgO/l will accomplish satisfactory removal from water contg. 20 ppm F in 2 min at 100°; in 20–30 min, at 40°. Light MgO has slightly greater adsorption capac. for F than heavy MgO. For treating public water supplies it is suggested to warm water to 40° in mixing tank, add MgO, and maintain suspended contact until anal. shows desired removal. Method eliminates step of boiling water as previously reported.—*CA*

The Removal of Silicic Acid from Water by the "Leuna" Method. E. Seyb. Chem.-Ztg., **78**:800 ('54). Silicic acid has adverse effects on high-pressure turbines if concn. is much above 6 mg/l. To attain permissible degree of concn. of boiler water, silicic acid content of feedwater must be below 1 mg/l. Removal is effected by admixing large amts. of MgO with softening lime. Use of dolomite in latter can supply most but not all MgO needed for best results. Carbonate hardness is reduced by SO_2 or series of ion-exchange treatments.—*CA*

Silicic Acid in Water as Corrosion-Inhibiting Agent. C. F. Hickethier. Industria y Quimica (Argentina), **16**:215:237 ('54). Even under unfavorable conditions, silicic acid in water can inhibit corrosion in participating in formation of protective layers, especially of practical importance with natural little mineralized waters with pH below neutrality, and satd. with O_2. Such protective layers by water with sufficient silica content have been observed in cast-iron, steel, and lead pipes. Water with not enough dissolved silica for forming protective layers can be corrected through addn. of sol. alkali silicates, suech as Na_2SiO_3, to result in 8–15 mg/l of SiO_2 in water.—*CA*

Deacidification of Waters Containing Carbonic Acid by Means of Dolomitic Lime. P. Hofer. Gesundh.-Ing. (Ger.), **75**:128 ('54). Waters of varying hardness and CO_2 content were passed through 3 serially arranged, half-burned dolomitic lime beds of given compn. and particle size. Lime removed CO_2 from all unbalanced waters to produce equiv. quant. of total hardness in effluent. Filter beds absorbed no CO_2. Corresponding lime neutralization was in ratio of 1 molecule $CaCO_3$ to 2 molecules of MgO. Although MgO removes 80% of free excess CO_2, function of $CaCO_3$ is equally important by assuring balanced effluent.—*CA*

Control of the Aniline Content of Water in Public Reservoirs. P. F. Obukhov. Gigiena i Sanit. (USSR), No. 9, p. 16 ('54). Olfactory threshold for aniline in H_2O is 50 mg/l at 50° or 100 at 5°. These figures cannot serve as sanitary criteria, however. At 5 mg/l or higher, reservoir waters acquire definite yellow tint. At 1–50 mg/l

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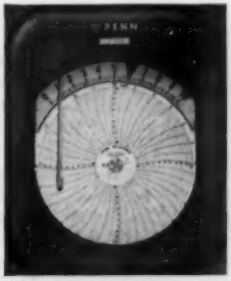

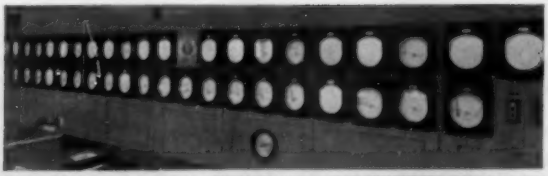

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THE PENN LINE IS COMPLETE FOR MATCHED METERING

DIFFERENTIAL PRODUCERS
- Venturi Tubes
- Flow Tubes
- Open Flow Nozzles
- Flumes and Weirs
- Orifice Plates
- Venturi Insert Nozzles
- ASME Nozzles

METERS
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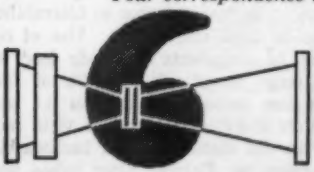
- Differential Pressure
- Variable Area
- Electric
- Mechanical
- Pneumatic
- Totalizing
- Indicating
- Recording
- Summation

CONTROLLERS

RECORDERS
- Rate of Flow
- Chemical Feed
- Liquid Level
- Loss of Head
- Pressure
- Temperature
- Pump Operation

TELEPHONE LINE TRANSMISSION

P-501



MATCHED METERING

PENN *Instruments*

DIVISION OF BURGESS-MANNING COMPANY

4102 Haverford Avenue • Philadelphia 4, Pennsylvania

(Continued from page 80)

concn. aniline does not appear to affect aq. microflora and is gradually destroyed, mainly by biochem.-oxidation processes. Such disturbances of O turnover are observed in reservoirs under conditions of restricted aeration (winter) when aniline content rises above 1–5 mg/l. Usual purif. and chlorination reduce aniline concn. by about 50% in range of 1–5 mg/l. Aniline causes increased absorption of Cl during chlorination treatment; such waters usually have characteristic odor.—*CA*

Fundamental Concepts of Rectangular Settling Tanks. A. C. Ingersol, J. E. McKee & N. H. Brooks. Proc. ASCE, 81, Separate No. 590, 28 pp. (Jan. '55). Theories of Hazen, Camp, and others indicating sedimentation is function of surface area and that for optimum efficiency settling tanks should be long, narrow, and relatively shallow, are reiterated and supported. Present method of comparing performance of settling tanks on basis of total percentage removal of suspended solids is inadequate. Instead, new method is proposed to compare performance of actual tank with ideal basin by means of "overflow residual efficiency." Exptl. results with wax spheres and silica verify to large extent theory that sedimentation is independent of depth, but these tests indicate that turbulence and scour, or one of these, at very shallow depths and high displacement veloc. may be more deleterious than formerly realized. Turbulent eddies will produce resuspension of fine, light sediment and lead to inefficient removal of these solids at horizontal velocs. much lower than those required to start bedload movement in accordance with Camp's formula based on Shield's data. Suspended-load equation is advanced as logical approach to subject of limiting horizontal veloc. to avoid scour bu turbulent eddies. This equation indicates that displacement velocs. should be much lower than Camp advocates; but since deep tanks are undesirable for several reasons, authors propose that shallow tanks be used in conjunction with method to prevent scour. Multiple inclined baffles appear to serve this purpose. Dispersion tests indicate that inlets are more critical than outlets in controlling short-circuiting. Outlets, however, modify flow nets, so that poor designs with high weir rates cause partially settled particles to be entrapped in updrafts. Given vol. of sludge will thicken more rapidly during early stages of compaction in shallow blanket than in deep one; hence, large bottom area should be provided for sludge thickening. Thickening is accelerated by inclined surfaces and by mech. action or vibrations. On basis of foregoing anal., it is suggested that further research and experimentation be conducted with view toward designing rectangular settling tanks for water and sewage works along following lines: with surface area corresponding to overflow rate of particle to be 100% removed; with high ratios, such as 10:1, of length to width in order to minimize inlet and outlet disturbances; with depths great enough to accommodate mech. scraping mechanisms (for example, 6′ or more); and with multiple inclined baffles to minimize scour and to improve thickening of sludge.—*PHEA*

Effect of Body Feed on the Filtration of Water Through Diatomite. H. E. Babbitt & R. E. Baumann. Univ. Ill. Eng. Expt. Sta. Bul., No. 425, 40 pp. ('54). Depending upon quant. of body feed, vol. of filtrate/lb of filter aid may be increased or decreased. These effects were completely investigated. Body feed refers to filter aid which is fed into precoated filters with unfiltered water. Quant. and nature of suspended solids in raw water will affect both filterability and required amt. of body feed. Filterability is defined as vol. of water at 68°F obtained/ft of head loss when diatomite filter precoated with 0.15 lb of std. filter aid/sq ft of filter is operated without body feed at flow rate of 3 gpm/sq ft to terminal head loss of 50 ft. New filterability test which measures filterability at specified body feed rate, generally 20 ppm, is suggested and might be used to det. amt. of body feed. Despite certain limitations, std. water filterability can be used to est. range of optimum body feeds. Optimum coagulant dosage seems to be major factor in filterability; this must be detd. empirically. Use of correct amts. of coagulants and body feed will produce large quant. of water/lb of filter aid with low turbidity, less than 0.1 ppm. "Polycel RCB-80" was found to yield more water than did diatomites, but backwashing was problem, as Polycel filter cakes were held more tightly to filtering septum. Both equip. used and tests themselves are described in detail.—*CA*

north, south, east, west...

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cuts costs, saves tax dollars!

Across America, thrift-conscious communities are recognizing the economy of "Century" Asbestos-Cement Pipe. Whether used in extending old water mains, or in installing new water distribution systems, "Century" Pipe brings the advantages of low cost . . . ease of installation . . . remarkable durability.

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K&M best in asbestos

Service Lines

Valves of various types are described in a 48-page illustrated catalog (Bul. 5403) available from Darling Valve & Mfg. Co., Williamsport, Pa.

A filter control system, combining effluent and wash water controllers, butterfly tight-closing control valves, control consoles, and all necessary instrumentation, is announced by Builders-Providence, Inc. Details of the "Pneumaster" system are given in a set of three bulletins (285-M10, 285-M41, and 470-M4) available from the company at 345 Harris Ave., Providence, R.I.

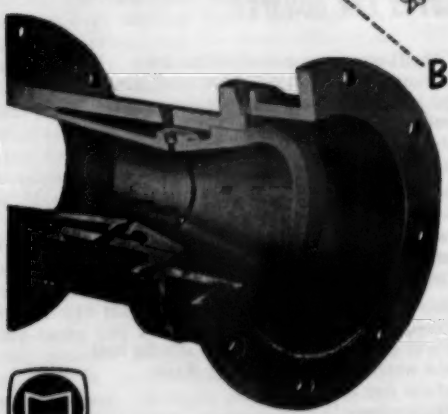
Two-stage pumps for boiler feed and other high-pressure applications, available in close-coupled and frame type construction in capacities up to 300 gpm at heads of 300–550 ft, are described in a 6-page brochure, Bul. 52B6105C, issued by Allis-Chalmers. Requests should be addressed to the company at 1026 S. 70th St., Milwaukee, Wis.

Water and waste treating equipment offered by Walker Process Equipment, Inc., is illustrated and described in a 24-page catalog, Bul. G-50, available from the company at Box 266, Aurora, Ill.

"Upflow" treatment for softening, alkalinity reduction, and the removal of undesirable constituents is described in a

(Continued on page 86 P&R)

When To Use



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- Use Dall Tubes when you need compact, minimum-cost installations: (average laying length only 1½ times line size).
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- Use Dall Tubes when you can't afford head loss: (highest pressure recovery of any velocity-increasing differential producer).
- For complete details write for Bulletin 115-L1. Builders-Providence, Inc., 365 Harris Ave., Providence 1, R. I.

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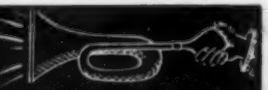
DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

B-I-F METERS FEEDERS CONTROLS

YOU WERE DOING THIS



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WERE BEING POURED -

HYDRO-TITE
(POWDER)

HYDRO-TITE

(POWDER)

For over 40 years HYDRO-TITE has been faithfully serving water works men everywhere. Self-caulking, self-sealing, easy-to-use. Costs about 1/5 as much as lead joints. Packed in 100 lb. moisture-proof bags.

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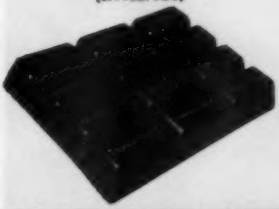

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The same dependable compound in solid form —packed in 50 lb. cartons—2 litters of pigs to the box—24 easy-to-handle Littlepigs. Easier to ship, handle and store.

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(REELS)

FIBREX

(REELS)

The sanitary, bacteria-free joint packing. Easier to use than jute and costs about half as much. Insures sterile mains and tight joints.

HYDRO-TITE

HYDRAULIC DEVELOPMENT CORPORATION

Service Lines

(Continued from page 84 P&R)

new, 20-page bulletin, No. 2204C, on the Permutit "Precipitator." Copies may be obtained from The Permutit Co., 330 W. 42nd St., New York 36, N.Y.

Automatic air release valves, Type AGFD, are described in Bul. 1204 (8 pages), available from Simplex Valve & Meter Co., 7 East Orange St., Lancaster, Pa.

Fluoride feeding by a continuous volumetric method is the subject of a 4-page booklet on the Model 50A "Fluoridizer," a product of Omega Machine Co. Requests for copies of Bul. 50-K3A should be sent to the company at 345 Harris Ave., Providence, R.I.

Asbestos textiles for various applications are described and illustrated in a 16-page manual issued by Johns-Manville, 22 E. 40th St., New York 16, N.Y. Copies can be obtained from the company.

Solenoid valves—two-way, general purpose—are described in a 2-page bulletin (No. 8210A) issued by Automatic Switch Co., 391 Lakeside Ave., Orange, N.J.

Precision indicators for laboratory electrical measurements ("Brown-Rubicon") are described in Data Sheet No. 10.02a, available from Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Electron microscope operation and applications are discussed in an 8-page booklet, titled "Questions and Answers on

(Continued on page 88 P&R)

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For almost a century Cole elevated tanks have been helping provide uniform water pressure, fire protection and adequate water reserve in scores of American cities.

Capacities 5,000 to 2,000,000 gallons—with hemispherical, ellipsoidal or conical bottoms. Also flat-bottom tanks for standpipe storage. Correctly built in accordance with AWWA specifications.

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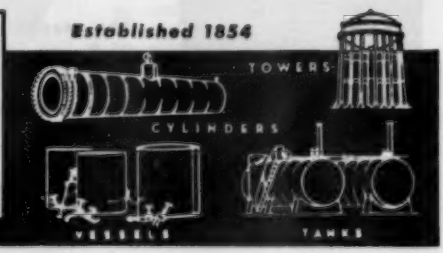

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Manhole steps—of all sewage treatment and waterworks structures—need *extra* corrosion resistance and dependability. Everdur* gives it to them . . . and adds the strength that really pays off . . . in greater safety.

Everdur Copper-Silicon Alloys deliver the same corrosion resistance—*plus ease and economy of operation over the years*—to gates, screens, guides and bolts, weirs, float chambers, troughs, stems and electrical conduit. Everdur is easily fabricated into lightweight, built-up wrought-metal assemblies.

Depending on type or composition, Everdur Alloys can be worked hot or cold. You can form, forge, weld and machine them. They are available in the form of plates, sheets, rods, tubes, electrical conduit and casting ingots.

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ANACONDA®
COPPER-SILICON ALLOYS
STRONG • WELDABLE • WORKABLE
CORROSION-RESISTANT

Service Lines

(Continued from page 86 P&R)

Electron Microscopes," available from Research & Control Instruments Div., North American Philips Co., 750 S. Fulton Ave., Mount Vernon, N.Y.

Packaged demineralization using the ion-selective membrane process is offered by Ionics, Inc. The equipment, which operates continuously and automatically, is available in capacities of 300–2,400 gph, at prices ranging from approximately $15,000 to $105,000. Information on basic principles, economics, characteristics, and operation is contained in a 24-page bulletin (No. 3) available from Ionics, Inc., 152—6th St., Cambridge 42, Mass.

Counters (mechanically or electrically actuated) for indicating, recording, and regulating machinery are described in a 4-page brochure (No. 54C) issued by Richardson Scale Co., Clifton, N.J.

Kraft paper markers—said to be waterproof, fade resistant, and highly visible—that can be slipped over surveyors' stakes to assist in grading operations are described in a 4-page brochure obtainable from Hargus Markers, 501 West H St., Brawley, Calif.

A drain or sampling valve with the stem seating on the outside of the valve body to make it completely self-draining is the subject of a 2-page bulletin, Data Unit No. 270, available from Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.

Caterpillar Tractor Co. has issued a number of new illustrated bulletins: Form

(Continued on page 90 P&R)

Depend on Cyanamid's ALUM for 6 good reasons

1. It feeds uniformly, without trouble, in solid or liquid form.
2. It has a wide pH range for effective coagulation.
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4. It gives maximum adsorption of suspended and colloidal impurities.
5. It causes minimum corrosion of feeding equipment.
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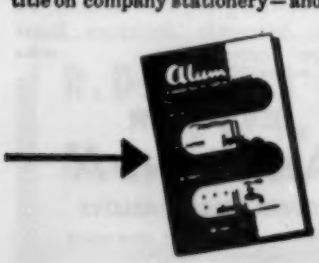
For a copy of "Alum—Commercial Aluminum Sulfate," please send us your name and title on company stationery—and would you also mention where you saw this offer?



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The new HAYS Model B Tapping Machine, now made of High Strength aluminum alloy, is light, compact, efficient. The HAYS Machine takes up less room in the ditch, requires fewer operations, is easier to handle, easier to operate, speeds up installation of all standard makes of corporation stops.

Your HAYS distributor or our representative will be glad to demonstrate the Model B . . . or write us about one for a trial on the job by your own men.

- Only 36 pounds to handle
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- Renewable bearing bronze feed yoke insert
- No disassembly to insert Corporation Stop
- Complete with chest

Join the A. W. W. A. HAYS is one of the eleven Charter Members of the Manufacturers Section of the American Water Works Association.

HAYS

WATER WORKS PRODUCTS
HAYS MANUFACTURING CO.
ERIE, PA.

Service Lines

(Continued from page 88 P&R)

31554, a broadside, covers two heavy-duty diesel engines (the D342 and the D339); Form D544, an 8-page booklet entitled "When Power Fails," discusses the installation of standby units; Form DE585, an 8-page booklet, describes the company's replacement parts service; and Form DE582, another 8-page booklet, shows how "Danger in the Heat Zone" of diesel engines can be avoided by sound metallurgy and careful machining. These publications can be obtained from dealers or by writing the company at Peoria, Ill.

A checklist (18 pages) of Diamond Alkali Co. literature on chemicals and their uses is available from the company at Union Commerce Bldg., Cleveland 14, Ohio.

Mountings to control vibration and shock in medium- and heavy-duty machinery are offered by T. R. Finn & Co. The "Finnflex Floating Pillow" mounting, consisting of a pair of rubber-in-shear isolators set at an angle between a semisteel base and cover, are described in a 4-page catalog, No. FP-55, available from Industrial Div., T. R. Finn & Co., 200 Central Ave., Hawthorne, N.J.

General Electric Co. is offering several illustrated bulletins: GEA-6280 (12 pages) describes the new vertical "Tri-Clad" medium induction motor; GEA-6234 (8 pages) covers the general-purpose "Thy-mo-trol" adjustable-speed drive; and GEA-6331 (12 pages) outlines the features of "Limitamp," a high-voltage motor control. Copies are obtainable from the company at Schenectady 5, N.Y.

6 Reasons why
WALKING BEAM FLOCCULATION
is now specified by water works engineers

1. Eliminates troublesome underwater bearings.
2. Eliminates expensive dry well construction.
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4. Produces quick responsive floc formation.
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Carson glands and bolts made of corrosion-resistant C-I-60 cast iron—last as long as cast iron pipe. Glands accommodate variations in pipe dimensions, insure uniform compression of rubber gasket.

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Do You Get These Advantages With the Coagulant You are Now Using?

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Users of Ferri-Floc enjoy these advantages—whatever your specific water treatment problem may be, you can depend on Ferri-Floc to do the job adequately, efficiently and economically—A partially hydrated ferric sulfate, Ferri-Floc is a free flowing granular salt which can be fed, with a few modifications, through any standard dry feed equipment. It is only mildly hygroscopic, thereby permitting easy and safe handling as well as storage in closed hoppers over long periods of time.

TENNESSEE CORPORATION Ferri-Floc FERRIC SULFATE

Water Treatment

Ferri-Floc coagulates surface or well waters, and it aids taste and odor control. It is effective in lime soda-ash softening, and is adaptable to treatment of practically all industrial water or wastes.

Sewage Treatment

Ferri-Floc coagulates waters and wastes over wide pH ranges. It provides efficient operation regardless of rapid variations of raw sewage, and is effective for conditioning sludge prior to vacuum filtration or drying on sand beds.

SULFUR-DIOXIDE HIGHEST QUALITY SO_2

SULFUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULFATE

COPPER SULFATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

Free New Booklet!

Let us send you without charge a 38-page booklet that deals specifically with all phases of coagulation.
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Section Meetings

Canadian Section: The thirty-fifth annual meeting of the Canadian Section, at Quebec City, Apr. 18–20, brought a registration of 714. This was the second time the convention has been held in that city.

New officers elected include: chairman —A. H. R. Thomas, manager, Public Utilities Commission, New Toronto, Ont.; vice-chairman—V. A. McKillop, manager, Public Utilities Commission, London, Ont.; trustees—G. H. Baker, North York, Ont.; H. P. Stockwell, Ottawa, Ont.; L. B. Allan, Metropolitan Toronto, Ont.; W. R. Godfrey, St. John, N.B.; G. R. Davis, Kingston, Ont.; and J. A. Tremblay, Quebec City, Que. The AWWA director for the next 3 years is C. G. R. Armstrong, Windsor, Ont. The representative of the Canadian Water Works Equipment Assn. on the Canadian Section Executive Committee is W. T. Randall, Long Branch, Ont., and the representative of the Maritime Branch is J. L.

(*Continued on page 94 P&R*)

3 MORE MUNICIPALITIES ARE NOW INSTALLING LARGE FERROSAND IRON & MANGANESE REMOVAL PLANTS

for economically removing iron and manganese from well water supplies

Advantages—

1. **Completely closed system. No repumping. Direct from wells thru filters to system.**
2. **No aeration, no chemical pretreatment, no settling tank, no sludge removal.**
3. **Effluent iron and manganese less than 0.2 ppm.**
4. **Simplified operation, non-technical supervision, small space requirement.**
5. **Low first cost, low operating and maintenance costs.**

On the market for over 25 years—hundreds of installations.

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The meter used by thousands of municipalities in the U. S.

WATER METERS

"Watch Dog" models . . . made in standard capacities from 20 g.p.m. up: frost-proof and split case in household sizes. Disc, turbine, or compound type.

SURE TO MEET YOUR SPECIFICATIONS FOR ACCURACY, LOW MAINTENANCE, LONG LIFE.

Before you invest in water meters, get acquainted with the design and performance advantages which make Worthington-Gamon Watch Dog Water Meters first choice of so many municipalities and private water companies in the United States.

WORTHINGTON-GAMON METER DIVISION

Worthington Corporation

296 SOUTH STREET, NEWARK 5, NEW JERSEY

OFFICES IN ALL PRINCIPAL CITIES

Section Meetings

(Continued from page 92 P&R)

McAvity of St. John, N.B. A. E. Berry remains as secretary-treasurer.

As in previous years, the program consisted of written papers and guided discussions. One of the featured papers was a symposium on water supply to suburban areas. Six persons, representing different cities in Canada, participated: T. V. Berry, Vancouver, B.C.; W. D. Hurst, Winnipeg, Man.; L. B. Allan, Metropolitan Toronto, Ont.; H. P. Stockwell, Ottawa, Ont.; L. L'Allier, Montreal, Que.; and J. D. Kline, Halifax, N.S. This symposium afforded an opportunity to compare the procedures followed in different centers for the extension of water supply to areas adjacent to large cities.

A paper by George Demers, consulting engineer, dealt with a new water supply line for Quebec City. Mr. Demers described the work that had been done by that city to bring water in from a distance to supply all needs. J. C. Bouchard of Montreal had an interesting paper based on his study of ozonation plants in France. The paper was timely, as a plant to utilize ozone treatment is now being installed at St. Hyacinthe, Que. Other papers included "Instrumentation of Water Purification Plants," by D. H. Matheson, Hamilton, Ont.; "Redesign of the South Porcupine Water Works System," by J. W. Argo, Toronto; and "The Beamsville Water Works Project," by R. V. Anderson, Toronto. Guided dis-

(Continued on page 96 P&R)

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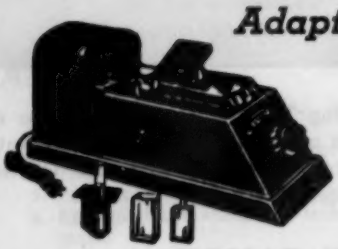

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Can be used for any determination in which color or turbidity can be developed in proportion to substance to be determined

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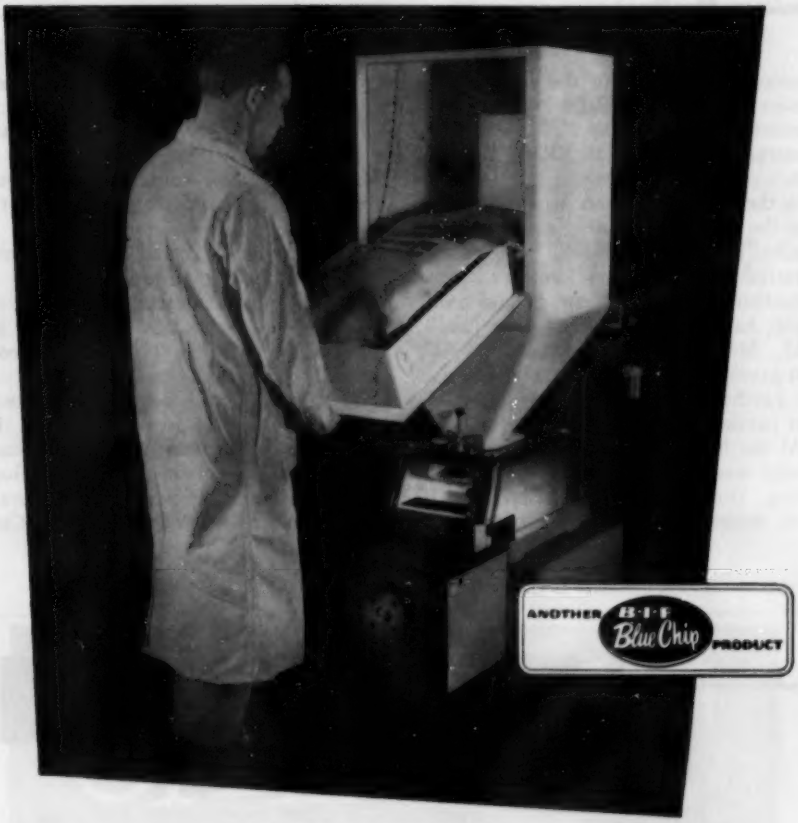

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For personnel safety —
For plant cleanliness —

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The only fluoride feeder with the dust-free bag loading hopper. For Bulletins, write Omega Machine Company, 365 Harris Avenue, Providence 1, Rhode Island.

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BIF METERS FEEDERS CONTROLS

Section Meetings

(Continued from page 94 P&R)

cussions on water rate trends and economics of meter repairs were chairmanned, respectively, by F. Y. Dorrance, Montreal, and V. A. McKillop, London, Ont.

In the business session, it was revealed that the membership of the Section had reached a new high of 630. The administrative office, operated jointly with the Canadian Institute on Sewage and Sanitation, had been functioning since Jan. 1, 1955. Morrison B. Cunningham, AWWA past-president, was the guest speaker at the luncheon on the opening day. He also participated in the business session.

At the banquet, a past-chairman's certificate was presented to C. G. R. Armstrong, Windsor. A cane was given to C. S. Anderson as a memento of his term as chairman. F. Y. Dorrance was announced as recipient of the Fuller Award. The Hunt Award for proficiency in water works operation was presented to William Keene, Pointe Claire, Que. Members of long standing received service certificates.

The Canadian Water Works Equipment Assn. played a prominent part in the meeting and was responsible for the operation of the "Club Room" and for entertainment. The "Club Room" continued to be a popular part of the meeting.

The Section was glad to pay tribute to two AWWA past-presidents, Linn H. Enslow and Morrison B. Cunningham. The former was given a Canadian Book in recognition of his election to Honorary Membership in AWWA, while Mr. Cun-

(Continued on page 98 P&R)

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Type SM with Worm Gear Drive on R-S Butterfly Valve.

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LimiTorque is self-contained and is applicable to all makes of valves. Any available power source may be used to actuate the operator: Electricity, water, air, oil, gas, etc.

A feature of LimiTorque is the torque limit switch which controls the closing thrust on the valve stem and prevents damage to valve operating parts.

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Section Meetings

(Continued from page 96 P&R)

ningham received another Canadian Book as a token of appreciation for his presence.

The ladies' functions proved very enjoyable. Of the 188 ladies registered, 148 were guests at a special luncheon. All ladies at the head table at the banquet received gifts under the able direction of Past-Chairman Ross L. Dobbin.

In summary, the meeting this year was a successful one, with a high registration and keen interest in the papers and discussions. The luncheon on opening day had an attendnce of 555, while the banquet attendance was 608.

A. E. BERRY
Secretary-Treasurer

Montana Section: The 30th annual meeting of the Montana Section was held on Friday and Saturday, Apr. 29 and 30, 1955, at the Finlen Hotel, Butte. The following officers were elected: chairman—John H. Morrison, of Morrison-Maierle, Inc., Helena; vice-chairman—Ben F. Chestnut, foreman, Great Falls Water Dept.; secretary-treasurer—A. W. Clarkson, assistant director, Div. of Environmental Sanitation, State Board of Health, Helena; trustees—R. G. Cronin, general foreman, Montana Power Co., Missoula, and Carl H. King, city engineer, Chinook.

Friday morning, opening addresses were given by Chairman John Dennis, AWWA Vice-President Frank C. Amsbary Jr., and National Director C. W. Eyer. The secretary-treasurer presented his report, followed by the reports of

(Continued on page 100 P&R)

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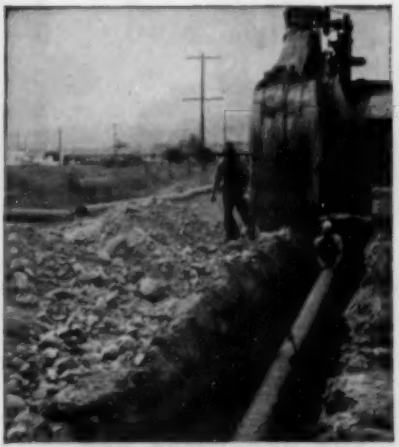

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Section Meetings

(Continued from page 98 P&R)

various committees, at the business session. The noon luncheon speaker was Arthur Lundford, vice-president of Anaconda Copper Mining Co. After lunch there was a tour of the company's installations and other points of interest in the Butte area.

The meeting reconvened Friday afternoon for a round-table discussion, led by John Morrison. Among the topics covered were: the economics of water softening, the costs of relocation due to highway construction, and fringe area water service. A number of significant points were brought out.

The annual dinner dance was held Friday evening at the Butte Country Club. Life Membership was awarded to H. M. Johnson, of the Anaconda Copper Mining Co., one of the founders of the Montana Section and long active in its affairs. It was announced that H. B. Foote, of Helena, had been elected to Honorary Membership in the Association and that John B. Hazen had been chosen to receive the Fuller Award.

The Saturday morning session opened with a paper on "Forming Improvement Districts," by Dave Smith, city attorney, Helena. He described the types of special improvement districts, the procedures to be followed in establishing them, and the methods of financing available. Next, Frank C. Amsbary Jr. gave a talk on public relations, in which he emphasized its importance and discussed the different approaches and publicity tools that can be employed. "Municipal Planning" was the subject of the final paper, by C. W. Eyer, city engineer, Glendive. He described the comprehensive plan that had been adopted to meet Glendive's rapid growth. As this problem is one that faces a number of Montana communities, Mr. Eyer's paper stimulated considerable discussion.

ARTHUR W. CLARKSON
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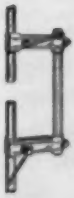
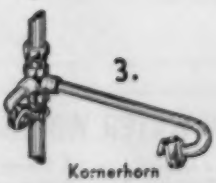


1. Cut supply line. Clamp not necessary but convenient

2. Add Connections



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NEW MEMBERS

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Aberley, Richard C., Civ. Engr., Brown & Caldwell, 66 Mint St., San Francisco, Calif. (Jul. '55) *P*

Abraham, Melvin H., Supt., Water Dept., 1642—119th St., Whiting, Ind. (Jul. '55) *MPD*

Alberta Div. of San. Eng., H. L. Hogge, Director, Dept. of Public Health, Administration Bldg., Edmonton, Alta. (Corp. M. Jul. '55) *MRPD*

Associated Eng. Services Ltd., Norman A. Lawrence, Pres., 10250—106th St., Edmonton, Alta. (Corp. M. Jul. '55) *PD*

Atchley, Ben D., Sr., Civ. Engr., McLemore & Atchley, 518 First National Bank Bldg., Shreveport, La. (Jul. '55) *M*

Bachman, Orville L., Sales Engr., Hersey Mfg. Co., 508 S. Monterey Pass Rd., Monterey Park, Calif. (Jul. '55) *MRD*

Baker, E. E.; *see* Economy Pumps

Beazely, A. E., Field Engr., Wallace & Tiernan, Ltd., 4504—1st St. S.E., Calgary, Alta. (Jul. '55)

Berry, Harold, Supt., Filter Plant, Madisonville, Ky. (Jul. '55) *P*

Big Rock Beach Water Co., Charles Pantel, Box 8, Malibu, Calif. (Corp. M. Jul. '55) *RP*

Blanchard, James U., Contracting Engr., Chicago Bridge & Iron Co., 1412 C & I Life Bldg., Houston 2, Tex. (Jul. '55) *RD*

Boettcher, Norbert A., Supt., Water & Sewer Utility, Bonduel, Wis. (Jul. '55) *MD*

Bond, John M., Water Supt., Box 28, Crossville, Tenn. (Jul. '55) *D*

Boyd, Vincent R., Sr.; *see* Boyd Constr. Co.

Boyd Constr. Co., Inc., Vincent R. Boyd, Sr., Pres., 109 E. 3rd St., Hobart, Ind. (Assoc. M. Jul. '55)

Bray, Frank M., Mgr., Water Works, Camden, Ark. (Jul. '55) *M*

Breedlove, Duke, Mgr., Booneville Water Co., Box CO, Booneville, Ark. (Jul. '51)

Briggs, Arthur A., Chief Engr., Water Works, 2125 Commerce St., Dallas, Tex. (Jul. '55) *RD*

Brisset des Nos, Andre, Group Engr., Eng. Div., 3161 Joseph St., Montreal 19, Que. (Jul. '55)

Brown, Albert; *see* Toccoa (Ga.) Water Dept.

Bryan, W. T.; *see* Duriron Co.

Burke, Bryan, Mgr., Fordyce Water Co., Fordyce, Ark. (Jul. '55)

Campagna, Benjamin Joseph, Asst. City Engr., Newark, Del. (Jul. '55) *M*

Campbell, Buck, Water Supt., Tyler, Tex. (Jul. '55) *MR*

Carroll, Onlac, Supt., Water Works, Box 512, Hereford, Tex. (Jul. '55) *M*

Corbin, M. D.; *see* Rohan Co.

Coughlin, F. J., Research & Development Dept., The Proctor & Gamble Co., M. A. & E. Bldg., Ivorydale, Cincinnati 17, Ohio (Jul. '55) *P*

Creel, John Calvin, Operator, Cit-Con Oil Corp., Lake Charles, La. (Jul. '55) *M*

Dabney, Henry L., Sr. Engr., State Dept. of Health, Bureau of San. Eng., 410 E. 5th St., Austin, Tex. (Jul. '55) *MRP*

David, Thomas C., Owner, Pan American Engrs., 1022—10th St., Alexandria, La. (Jul. '55) *RPD*

Davis, Samuel G., Sales Eng., Box 9053, Metairie, La. (Jul. '55) *MP*

deCelle, O. A.; *see* deCelle, O. A., & Assocs.

deCelle, O. A., & Assocs., O. A. deCelle, Pres., 4900 W. Madison St., Chicago 44, Ill. (Assoc. M. Jul. '55)

Dempsey, W. T., Cons. Engr., 37 King St. E., Oshawa, Ont. (Jul. '55)

Dickinson, William Dewoody, Jr., Cons. Engr., Dickinson Eng. Co., 115 N. Spring St., Little Rock, Ark. (Jul. '55) *P*

Dilworth, L. B., Plant Operator, Water Works, Camden, Ark. (Jul. '55) *RP*

Dowling, George E., Munic. Engr., State Inspection & Rating Bureau, 512 Hall Bldg., Little Rock, Ark. (Jul. '55) *R*

Duriron Co., Inc., W. T. Bryan, Mgr., Alloy & Anode Sales, 450 N. Findlay St., Dayton 1, Ohio (Assoc. M. Jul. '55)

Economy Pumps, Inc., E. E. Baker, Vice-Pres., 19th & Lehigh Ave., Philadelphia 32, Pa. (Assoc. M. Jul. '55)

Emmo, Frank E.; *see* Osborne, Raymond G., Labs.

Fabares, J. N., Supt., St. Charles Parish Water Works Dist. No. 1, Box 147, New Sarpy, La. (Jul. '55) *P*

Garner, John J., Asst. San. Engr., Lake County Water Dept., Court House, Painesville, Ohio (Jul. '55) *MPD*

Gartelmann, Raymond W., Sales Engr., Turbine Equipment Co., 63 Vesey St., New York 7, N.Y. (Jul. '55) *D*

Giacomazzi, Plinio A., 621 Pleasant St., Santa Paula, Calif. (Jul. '55)

Gilmore, Rex D., Town Mgr., Smyrna, Del. (Jul. '55) *M*

Glasson, James Louis, Water Supt., Coleman, Tex. (Jul. '55) *M*

Grusenmeyer, X. H., Asst. Mgr., Campton Heights Water Service, Box 124, Rohnerville, Calif. (Jul. '55) *M*

Hendrickson, Curtis, Supervisor, Sewage Treatment, Public Service Board, Box 511, El Paso, Tex. (Jul. '55)

Hogge, H. L.; *see* Alberta Div. of San. Eng.

(Continued on page 104 P&R)

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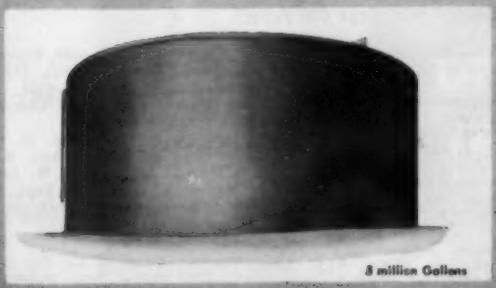
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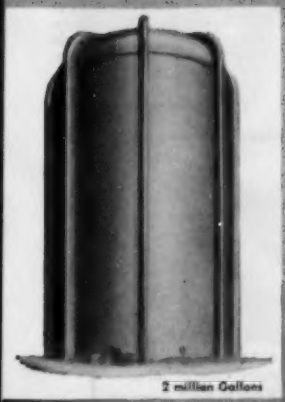
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(*Continued from page 102 P&R*)

Holt, Robert M., Sales Engr., Louisiana Well Co., Box 1002, Monroe, La. (Jul. '55) *R*

Kelly, Richard A., Supt., Munic. Light & Water Dept., Munic. Light & Water Plant, E. Center St., Madisonville, Ky. (Jul. '55) *MRD*

Koester, Harry M., Director of Finance, Water Board, Box 2449, San Antonio, Tex. (Jul. '55) *M*

Lamar, Curtis, Water & Sewer Supt., City Hall, Borger, Tex. (Jul. '55)

Lawrence, Norman A.; *see* Associated Eng. Services

Ledbetter, John J., Cons. Engr., 2007 Hopi Trail, Box 5087, Austin, Tex. (Jul. '55) *R*

Loos, John C., Jr., San. Engr., Warren & Van Praag, Inc., 253 S. Park, Decatur, Ill. (Jul. '55) *MRP*

Lumadue, Clyde, Supt. of Constr., E. A. Gallagher & Sons, Pier 3, North Philadelphia, Pa. (Jul. '55)

Lyman, E. D., Director, Omaha-Douglas County Health Dept., 1201 S. 42nd St., Omaha 5, Neb. (Jul. '55)

Mann, Robert M., Asst. Utilities Engr., California Public Utilities Com., 145 S. Spring St., Los Angeles 12, Calif. (Jul. '55) *D*

Mathews, Milford A., Sales Repr., Neptune Meter Co., 315 Cole St., Dallas 7, Tex. (Jul. '55) *RP*

Mayne, Paul J., Cons. Civ. Engr., Box 295, Opelousas, La. (Jul. '55) *PD*

Montgomery, George S., Water & Sewer Supt., McLennan County Water Control & Improvement Dist. No. 2, Elm Mott, Tex. (Jul. '55) *MD*

Murray, Arthur Robert, Lab. Technician, Div. of Water & Sewers, 827 E. Jefferson, Phoenix, Ariz. (Jul. '55) *P*

Oberton, Arthur C. E., Student, Dept. Civ. & San. Eng., Massachusetts Inst. of Technology, 259 Westgate W., Cambridge, Mass. (Jr. M. Jul. '55) *M*

Osborne, Raymond G., Labs., Inc., Frank E. Emme, Civ. Engr., 110 W. 9th St., Los Angeles 15, Calif. (Corp. M. Jul. '55)

Pantel, Charles; *see* Big Rock Beach Water Co.

Paquette, Edmund M., Supt., Water Dept., Spaulding-Bridgeport Metropolitan Dist., 3813 East Rd., Saginaw, Mich. (Jul. '55) *D*

Pearce, William H., Jr., Supt., Water Works, Many, La. (Jul. '55) *MR*

Quadreny G., Jorge L., Public Health Engr., Calle 9 No. 810 Apdo. 4, Entre 14 y 16 Almenda, Marianao, Havana, Cuba (Jul. '55)

Roach, J. B., Chemist, Water Dept., Fort Smith, Ark. (Jul. '55) *P*

Robinson, L. B., Supt., Water Works, City Hall, Olney, Tex. (Jul. '55) *MR*

Rohan Co., Inc., M. D. Corbin, Pres., 206 Franklin Ave., Box 887, Waco, Tex. (Assoc. M. Jul. '55)

Romney, J. H., Sales Repr., Dresser Mfg. Div., 208 Birch St., Park Forest, Ill. (Jul. '55) *PD*

Rourke, A. J.; *see* Utility Analysis

Sacra, William E., Jr., Student, Dept. of Civ. Eng., Rutgers Univ., New Brunswick, N.J. (Jr. M. Jul. '55) *M*

Schwab, Jerome J., Sales Mgr., Fischer & Porter Co., 516 Guardian Bldg., St. Paul 1, Minn. (Jul. '55) *MRP*

Sealy, W. E., Supt., Water & Sewer Depts., 304 S. 1st St., Lamesa, Tex. (Jul. '55) *M*

Shields, James G., Assoc. Utilities Engr., 145 S. Spring, Rm. 1000, Los Angeles 12, Calif. (Jul. '55) *MRPD*

Stelb, Ishmael J., Supt., Water Works, Maringouin, La. (Jul. '55) *M*

Zavala, Alfonso, Water Works Design San. Engr., Servicio Cooperative Interamericano de Salud Publica, Ministerio de Salud Publica, Lima, Peru (Jul. '55) *PD*

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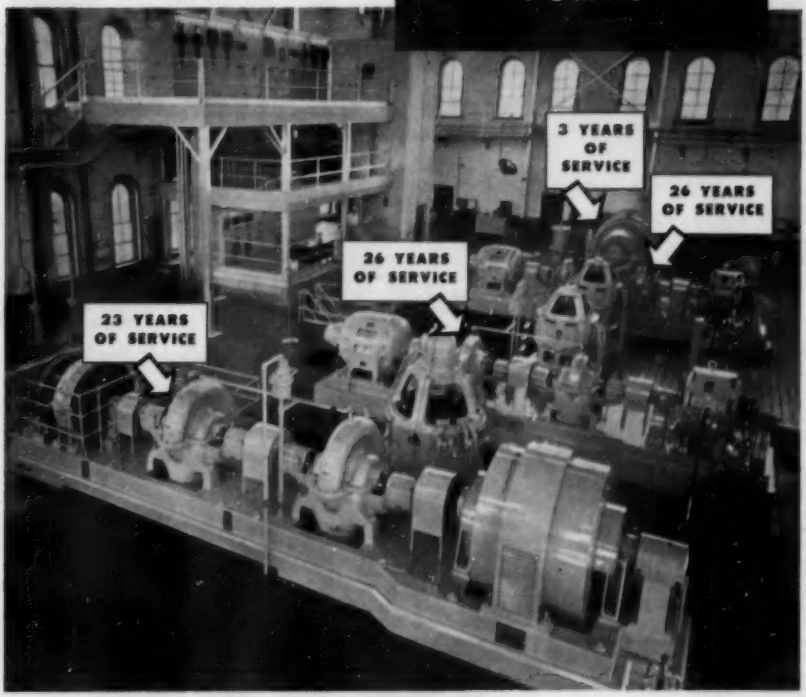

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Blockson Chemical Co.

Fluoride Feeders:
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Fischer & Porter Co.
Omega Machine Co. (Div., B-I-F Industries)
Wallace & Tiernan Co., Inc.

Furnaces:
Jos. G. Pollard Co., Inc.

Gages, Liquid Level:
Builders-Providence, Inc.
Fischer & Porter Co.
Infilco Inc.
Penn Industrial Instrument Div.
Simplex Valve & Meter Co.

Gages, Loss of Head, Rate of Flow, Sand Expansion:
Builders-Providence, Inc.
Fischer & Porter Co.
Infilco Inc.
Penn Industrial Instrument Div.
Simplex Valve & Meter Co.

Gasholders:
Chicago Bridge & Iron Co.
Hammond Iron Works
Pittsburgh-Des Moines Steel Co.

Gaskets, Rubber Packing:
James B. Clow & Sons
Johns-Manville Corp.

Gates, Shear and Sluice:
Armco Drainage & Metal Products, Inc.
Chapman Valve Mfg. Co.
James B. Clow & Sons
Morse Bros. Mchy. Co.
Mueller Co.
R. D. Wood Co.

with **CLOW** *mechanical joint*

SPLIT SLEEVES

Don't be caught short this winter without a stock of Mechanical Joint Split Sleeves. Be prepared with sleeves for every size pipe in your system. Clow split sleeves fit all classes of cast iron pipe, and make a fast, simple, permanent repair.

F-1200 Straight Split Sleeves will repair breaks in the barrel of the pipe. F-1205 Bell Split Sleeves will repair damaged joints of underground pipe, as well as the barrel.

Clow Split Sleeves are shipped complete with joint accessories. All sizes 3" through 16" available for immediate shipment.

James B. Clow & Sons
Inc.

201-299 N. Talman Avenue, Chicago 80, Illinois
Subsidiaries: Eddy Valve Company • Iowa Valve Company

Gears, Speed Reducing:
DeLaval Steam Turbine Co.
Philadelphia Gear Works, Inc.

Glass Standards—Colorimetric Analysis Equipment:
Klett Mfg. Co.
Wallace & Tiernan Inc.

Goosenecks (with or without Corporation Stops):
James B. Clow & Sons
Hays Mfg. Co.
Mueller Co.

Hydrants:
James B. Clow & Sons
Darling Valve & Mfg. Co.
M. Greenberg's Sons
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co., Inc.
M & H Valve & Fittings Co.
Mueller Co.
A. P. Smith Mfg. Co.
Rensselaer Valve Co.
R. D. Wood Co.

Hydrogen Ion Equipment:
Wallace & Tiernan Inc.

Ion Exchange Materials:
Cochrane Corp.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco Inc.
Permutit Co.
Roberts Filter Mfg. Co.

Iron, Pig
Woodward Iron Co.

Iron Removal Plants:
American Well Works
Chain Belt Co.
Cochrane Corp.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco Inc.
Permutit Co.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.

Jointing Materials:
Hydraulic Development Corp.
Johns-Manville Corp.
Leadite Co., Inc.

Joints, Mechanical, Pipe:
American Cast Iron Pipe Co.
Cast Iron Pipe Research Assn.
James B. Clow & Sons
Dresser Mfg. Div.
Trinity Valley Iron & Steel Co.
United States Pipe & Foundry Co.
R. D. Wood Co.

Leak Detectors:
Jos. G. Pollard Co., Inc.

Lime Slakers and Feeders:
Dorr-Oliver Inc.
General Filter Co.
Infilco Inc.
Omega Machine Co. (Div., B-I-F Industries)
Permutit Co.

Magnetic Dipping Needles:
W. S. Darley & Co.

Meter Boxes:
Ford Meter Box Co.
Pittsburgh Equitable Meter Div.

Meter Couplings and Yokes:
Badger Meter Mfg. Co.
Dresser Mfg. Div.
Ford Meter Box Co.
Hays Mfg. Co.
Hersey Mfg. Co.
Mueller Co.
Neptune Meter Co.
Pittsburgh Equitable Meter Div.
Worthington-Gamon Meter Co.

Meter Reading and Record Books:
Badger Meter Mfg. Co.

Meter Testers:
Badger Meter Mfg. Co.
Ford Meter Box Co.
Hersey Mfg. Co.
Neptune Meter Co.
Pittsburgh Equitable Meter Div.

Meters, Domestic:
Badger Meter Mfg. Co.
Buffalo Meter Co.
Hersey Mfg. Co.
Neptune Meter Co.
Pittsburgh Equitable Meter Div.
Well Machinery & Supply Co.
Worthington-Gamon Meter Co.

Meters, Filtration Plant, Pumping Station, Transmission Line:
Builders-Providence, Inc.
Fischer & Porter Co.
Foster Eng. Co.
Infilco Inc.
Penn Industrial Instrument Div.
Simplex Valve & Meter Co.

Meters, Industrial, Commercial:
Badger Meter Mfg. Co.
Buffalo Meter Co.
Builders-Providence, Inc.
Fischer & Porter Co.
Hersey Mfg. Co.
Neptune Meter Co.
Pittsburgh Equitable Meter Div.
Simplex Valve & Meter Co.
Well Machinery & Supply Co.
Worthington-Gamon Meter Co.

Mixing Equipment:
Chain Belt Co.
General Filter Co.
Infilco Inc.

Paints
Inertol Co., Inc.

Pipe, Asbestos-Cement:
Johns-Manville Corp.
Keasbey & Mattison Co.

Pipe, Brass:
American Brass Co.

Pipe, Cast Iron (and Fittings):
American Cast Iron Pipe Co.
Cast Iron Pipe Research Assn.
James B. Clow & Sons
Trinity Valley Iron & Steel Co.
United States Pipe & Foundry Co.
R. D. Wood Co.

Pipe, Cement Lined:
American Cast Iron Pipe Co.
Cast Iron Pipe Research Assn.
James B. Clow & Sons
United States Pipe & Foundry Co.
R. D. Wood Co.

Pipe, Concrete:
American Concrete Pressure Pipe Assn.
American Pipe & Construction Co.
Lock Joint Pipe Co.

Pipe, Copper:
American Brass Co.

Pipe, Steel:
Armco Drainage & Metal Products, Inc.
Bethlehem Steel Co.

Pipe Coatings and Linings:
The Barrett Div.
Cast Iron Pipe Research Assn.
Centriline Corp.
Inertol Co., Inc.
Koppers Co., Inc.
Reilly Tar & Chemical Corp.

Pipe Cutters
James B. Clow & Sons
Ellis & Ford Mfg. Co.
Jos. G. Pollard Co., Inc.
Reed Mfg. Co.
A. P. Smith Mfg. Co.
Spring Load Mfg. Corp.

Pipe Jointing Materials; see Jointing Materials

Pipe Locators:
W. S. Darley & Co.
Jos. G. Pollard Co., Inc.

Pipe Vises
Spring Load Mfg. Corp.

Plugs, Removable:
James B. Clow & Sons
Jos. G. Pollard Co., Inc.
A. P. Smith Mfg. Co.

Potassium Permanganate
Carus Chemical Co.

Pressure Regulators:
Allis-Chalmers Mfg. Co.
Foster Eng. Co.
Mueller Co.
Ross Valve Mfg. Co.

Pumps, Boiler Feed:
DeLaval Steam Turbine Co.

Pumps, Centrifugal:
Allis-Chalmers Mfg. Co.
American Well Works
DeLaval Steam Turbine Co.
Morse Bros. Mchy. Co.
C. H. Wheeler Mfg. Co.

Pumps, Chemical Feed:
Infilco Inc.
Proportioneers, Inc.
Wallace & Tiernan Inc.

Pumps, Deep Well:
American Well Works
Layne & Bowler, Inc.

Pumps, Diaphragm:
Dorr-Oliver Inc.
Morse Bros. Mchy. Co.

Pumps, Hydrant:
W. S. Darley & Co.
Jos. G. Pollard Co., Inc.

Pumps, Hydraulic Booster:
Ross Valve Mfg. Co.

Pumps, Sewage:
Allis-Chalmers Mfg. Co.
DeLaval Steam Turbine Co.
C. H. Wheeler Mfg. Co.

Pumps, Sump:
DeLaval Steam Turbine Co.
C. H. Wheeler Mfg. Co.

Pumps, Turbine:
DeLaval Steam Turbine Co.
Layne & Bowler, Inc.

Recorders, Gas Density, CO_2, NH_3, SO_2, etc.:
Fischer & Porter Co.
Permutit Co.
Wallace & Tiernan Inc.

Recording Instruments:
Fischer & Porter Co.
Infilco Inc.
Penn Industrial Instrument Div.
Wallace & Tiernan Inc.

Reservoirs, Steel:
Chicago Bridge & Iron Co.
Graver Water Conditioning Co.
Hammond Iron Works
Pittsburgh-Des Moines Steel Co.

Sand Expansion Gages; see Gages

Sleeves; see Clamps

Sleeves and Valves, Tapping:
James B. Clow & Sons
M & H Valve & Fittings Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.

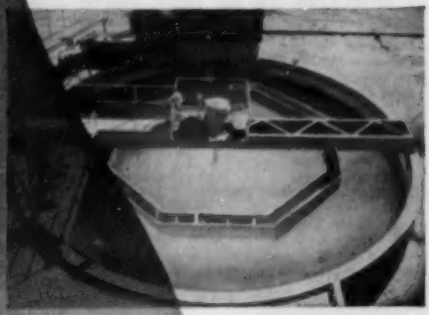
Sludge Blanket Equipment:
General Filter Co.
Graver Water Conditioning Co.
Permutit Co.

Sodium Hexametaphosphate:
Blockson Chemical Co.
Calgon, Inc.

Sodium Silicate
Philadelphia Quartz Co.

Why General Filter?

There are many reasons why municipalities and industries have installed General Filter water treating plants:



INSTALLATION SUPERVISION . . . General Filter "job-engineers" each installation to the consulting engineer's specification . . . supervises the installation and trains the personnel who will work with the equipment.

OPERATIONAL DEPENDABILITY . . . for twenty years General Filter has concentrated all of its efforts toward "better water treatment". Their efforts have produced water treating plants and equipment that are completely dependable.

ENGINEERING KNOW-HOW . . . General Filter's design and construction engineers are familiar with the problems involved in water treatment.

GREATER ECONOMY . . . the only real test of economy is a long-term test. General Filter plants stand up over the years providing "better water" with minimum maintenance, longer trouble-free, smoother operation.

Find out why you should specify General Filter . . . Write today for detailed information regarding your water treatment problems.

General Filter Company
AMES, IOWA
"yours for better water treatment"

AERATORS • FILTERS • TASTE AND ODOR • ALKALINITY CONTROL • HIGH CAPACITY RESINOUS ZEOLITE • IRON RUST REMOVAL • DEMINERALIZATION • SOFTENERS

Softeners:
Cochrane Corp.
Dorr-Oliver Inc.
General Filter Co.
Graver Water Conditioning Co.
Hungerford & Terry, Inc.
Infilco Inc.
Permutit Co.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.

Softening Chemicals and Compounds:
Calgon, Inc.
Cochrane Corp.
General Filter Co.
Infilco Inc.
Morton Salt Co.
Permutit Co.
Tennessee Corp.

Standpipes, Steel:
Chicago Bridge & Iron Co.
R. D. Cole Mfg. Co.
Graver Water Conditioning Co.
Hammond Iron Works
Pittsburgh-Des Moines Steel Co.

Steel Plate Construction:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
R. D. Cole Mfg. Co.
Graver Water Conditioning Co.
Hammond Iron Works
Pittsburgh-Des Moines Steel Co.

Stops, Curb and Corporation:
Hays Mfg. Co.
Mueller Co.

Storage Tanks; see Tanks

Strainers, Suction:
James B. Clow & Sons
M. Greenberg's Sons
Johnson, Edward E., Inc.
R. D. Wood Co.

Surface Wash Equipment:
Cochrane Corp.
Permutit Co.

Swimming Pool Sterilization:
Fischer & Porter Co.
Omega Machine Co. (Div., B-I-F Industries)
Pronortioneers, Inc.
Wallace & Tiernan Inc.

Tanks, Steel:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
R. D. Cole Mfg. Co.
Graver Water Conditioning Co.
Hammond Iron Works
Pittsburgh-Des Moines Steel Co.

Tapping-Drilling Machines:
Hays Mfg. Co.
Mueller Co.
A. P. Smith Mfg. Co.

Tapping Machines, Corp.:
Hays Mfg. Co.
Mueller Co.

Taste and Odor Removal:
Cochrane Corp.
Fischer & Porter Co.
General Filter Co.
Graver Water Conditioning Co.
Industrial Chemical Sales Div.
Infilco Inc.
Permutit Co.
Pronortioneers, Inc.
Wallace & Tiernan Inc.

Tenoning Tools
Spring Load Mfg. Corp.

Turbidimetric Apparatus (For Turbidity and Sulfate Determinations):
Wallace & Tiernan Inc.

Turbines, Steam:
DeLaval Steam Turbine Co.

Turbines, Water:
DeLaval Steam Turbine Co.

Valve Boxes:
James B. Clow & Sons
Ford Meter Box Co.
M & H Valve & Fittings Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
Trinity Valley Iron & Steel Co.
R. D. Wood Co.

Valve-Inserting Machines:
Mueller Co.
A. P. Smith Mfg. Co.

Valves, Altitude:
Ross Valve Mfg. Co., Inc.
S. Morgan Smith Co.

Valves, Butterfly, Check, Flap, Foot, Hose, Mud and Plug:
Chapman Valve Mfg. Co.
James B. Clow & Sons
DeZurik Shower Co.
M. Greenberg's Sons
M & H Valve & Fittings Co.
Mueller Co.
Henry Pratt Co.
Rensselaer Valve Co.
S. Morgan Smith Co.
R. D. Wood Co.

Valves, Detector Check:
Hersey Mfg. Co.

Valves, Electrically Operated:
Chapman Valve Mfg. Co.
James B. Clow & Sons
Crane Co.
Darling Valve & Mfg. Co.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Philadelphia Gear Works, Inc.
Henry Pratt Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
S. Morgan Smith Co.

Valves, Float:
James B. Clow & Sons
Henry Pratt Co.
Ross Valve Mfg. Co., Inc.

Valves, Gate:
Chapman Valve Mfg. Co.
James B. Clow & Sons
Crane Co.
Darling Valve & Mfg. Co.
Dresser Mfg. Div.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co., Inc.
M & H Valve & Fittings Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Hydraulically Operated:
Chapman Valve Mfg. Co.
James B. Clow & Sons
Crane Co.
Darling Valve & Mfg. Co.
DeZurik Shower Co.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Philadelphia Gear Works, Inc.
Henry Pratt Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
S. Morgan Smith Co.
R. D. Wood Co.

Valves, Large Diameter:
Chapman Valve Mfg. Co.
James B. Clow & Sons
Crane Co.
Darling Valve & Mfg. Co.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co., Inc.
M & H Valve & Fittings Co.
Mueller Co.
Henry Pratt Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
S. Morgan Smith Co.
R. D. Wood Co.

Valves, Regulating:
DeZurik Shower Co.
Foster Eng. Co.
Mueller Co.
Henry Pratt Co.
Ross Valve Mfg. Co.
S. Morgan Smith Co.

Valves, Swing Check:
Chapman Valve Mfg. Co.
James B. Clow & Sons
Crane Co.
Darling Valve & Mfg. Co.
M. Greenberg's Sons
M & H Valve & Fittings Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Venturi Tubes
Builders-Providence, Inc.
Infilco Inc.
Penn Industrial Instrument Div.
Simplex Valve & Meter Co.

Waterproofing
Inertol Co., Inc.

Water Softening Plants; see Softeners

Water Supply Contractors:
Layne & Bowler, Inc.

Water Testing Apparatus:
Wallace & Tiernan Inc.

Water Treatment Plants:
Allis-Chalmers Mfg. Co.
American Well Works
Chain Belt Co.
Chicago Bridge & Iron Co.
Cochrane Corp.
Dorr-Oliver Inc.
Fischer & Porter Co.
General Filter Co.
Graver Water Conditioning Co.
Hammond Iron Works
Hungerford & Terry, Inc.
Infilco Inc.
Permutit Co.
Pittsburgh-Des Moines Steel Co.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.
Wallace & Tiernan Inc.

Well Drilling Contractors:
Layne & Bowler, Inc.

Well Screens
Johnson, Edward E., Inc.

Wrenches, Ratchet:
Dresser Mfg. Div.

Zeolite; see Ion Exchange Materials

A complete Buyers' Guide to all water works products and services offered by AWWA Associate Members appears in the 1955 AWWA Directory.

STOP High Installation Costs with—

Standard CHAPMAN SLUICE GATES

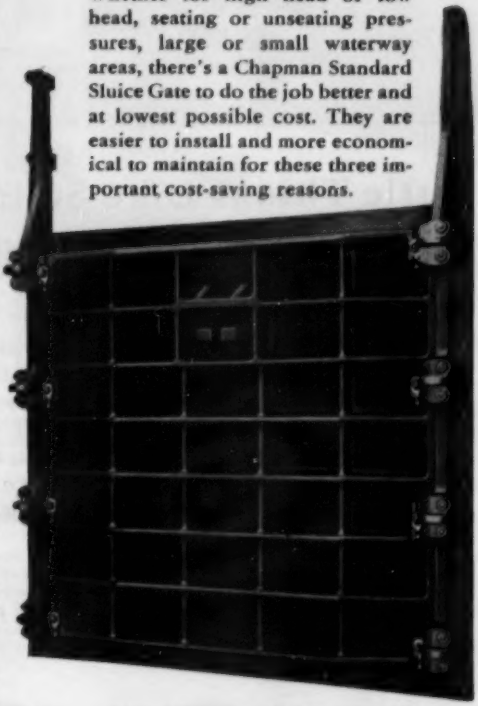
1 ***Wide Selection*** — There are over 300 types and sizes of standard Chapman Sluice Gates to meet most conditions. Controls are for either manual, hydraulic or electric motor driven operation. Many special designs and sizes are also available.

2 ***Easy Installation*** — Chapman Standard Sluice Gates are faster and simpler to install because component parts are interchangeable. They fit perfectly, every time, without expensive and time consuming matchmaking or field alterations.

3 ***Replacement Parts*** — Standardized manufacture means that should repair and replacement parts be needed, they will fit perfectly into place without fitting. Servicing and repairs can be done at the job with minimum expense.

Chapman Standard Sluice Gates have been job-tested in waterworks, sewage works and flood control projects across the country. They are your assurance of top performance at lowest cost. If your current project calls for sluice gates, be sure to write for revised Catalog 25A and check the big advantages that only the Chapman Standard Sluice Gate Line offers.

Whether for high head or low head, seating or unseating pressures, large or small waterway areas, there's a Chapman Standard Sluice Gate to do the job better and at lowest possible cost. They are easier to install and more economical to maintain for these three important cost-saving reasons.



The CHAPMAN VALVE Manufacturing Company

INDIAN ORCHARD, MASSACHUSETTS

Little Things Like Stainless Steel Trim
For The Best Corrosion Protection

Many potable waters are corrosive to meters—some more so than others. Rockwell guards its Arctic and Tropic meters against corrosive attack through the use of carefully selected and treated stainless steel at such vulnerable points as the division plate, driving dog, disc spindle, stuffing box spindle and screws.

If corrosion is a problem with you, contact your nearby Rockwell office for the best advice and protection you can get.

The Symbol for Service, Quality and Performance in Water Meters

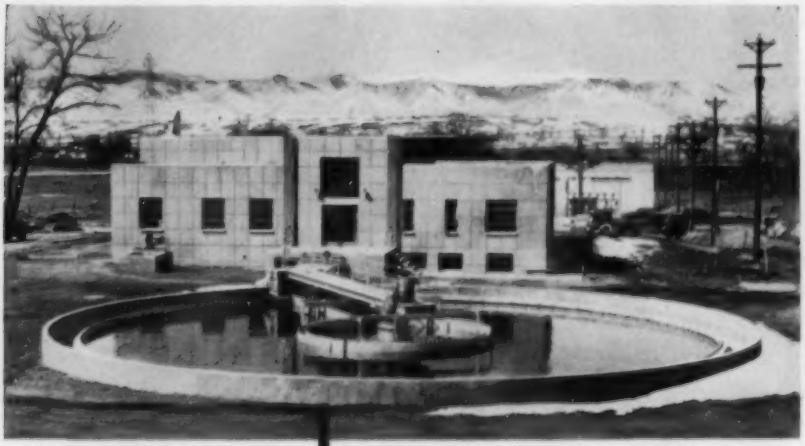
ROCKWELL MANUFACTURING COMPANY

PITTSBURGH 8, PA. Atlanta Boston Charlotte Chicago Dallas Houston
Los Angeles Midland, Texas N. Kansas City, Mo. New York Philadelphia Pittsburgh
San Francisco Seattle Shreveport Tulsa

in water treatment problems...

you won't find identical twins

No two water treatment problems are exactly alike. The right solution to each can only be arrived at after a careful study of the local conditions. Variables such as raw water composition, rate of flow and results required automatically rule out the cure-all approach. The installation shown below is a good example of how equipment should be selected to fit the job . . . and not vice versa.



Englewood, Colorado

Gets Turbidity Removal and Water Softening with One Hydro-Treator Unit

The problem at the City of Englewood, a suburb of Denver, was to get turbidity removal in the summer periods and water softening in the wintertime at a reasonable installed cost. The major source of the water supply is the South Platte River whose headwaters are fed by the snow stored in the Rocky Mountains.

A study of the problem involved showed that the Dorrco Hydro-Treator would handle both conditions efficiently. A 70 ft. diameter Hydro-Treator with capacity of 7.5 MGD has done the job effectively. Now the water requirements at Englewood have increased due to population growth, and at this time an identical Hydro-Treator is being added to double treating capacity.

If you'd like more information on the complete line of Dorr-Oliver water treatment equipment, write for Bulletin No. 9141, Dorr-Oliver Incorporated, Stamford, Conn., or in Canada, 26 St. Clair Avenue E., Toronto 5.

Every day, nearly 8 billion gallons of water are treated with Dorr-Oliver equipment.

*Hydro-Treator Trademark Reg. U. S. Pat. Off.
Consulting Engineer: DALE H. BEA, Denver, Colorado

DORR-OLIVER
INCORPORATED
WORLD WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

LEADITE

Trade Mark Registered U. S. Pat. Office

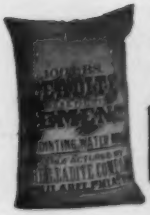
Jointed for . . . Permanence with LEADITE

Generally speaking, most Water Mains are buried beneath the Earth's surface, to be forgotten,—they are to a large extent, laid for permanency. Not only must the pipe itself be dependable and long lived,—but the joints also must be tight, flexible, and long lived,—else leaky joints are apt to cause the great expense of digging up well-paved streets, beautiful parks and estates, etc.

Thus the "jointing material" used for bell and spigot Water Mains MUST BE GOOD,—MUST BE DEPENDABLE,—and that is just why so many Engineers, Water Works Men and Contractors aim to PLAY ABSOLUTELY SAFE, by specifying and using LEADITE.

Time has proven that LEADITE not only makes a tight durable joint,—but that it improves with age.

The pioneer self-caulking material for c. i. pipe.
Tested and used for over 40 years.
Saves at least 75%



THE LEADITE COMPANY
Girard Trust Co. Bldg. Philadelphia, Pa.

No Caulking